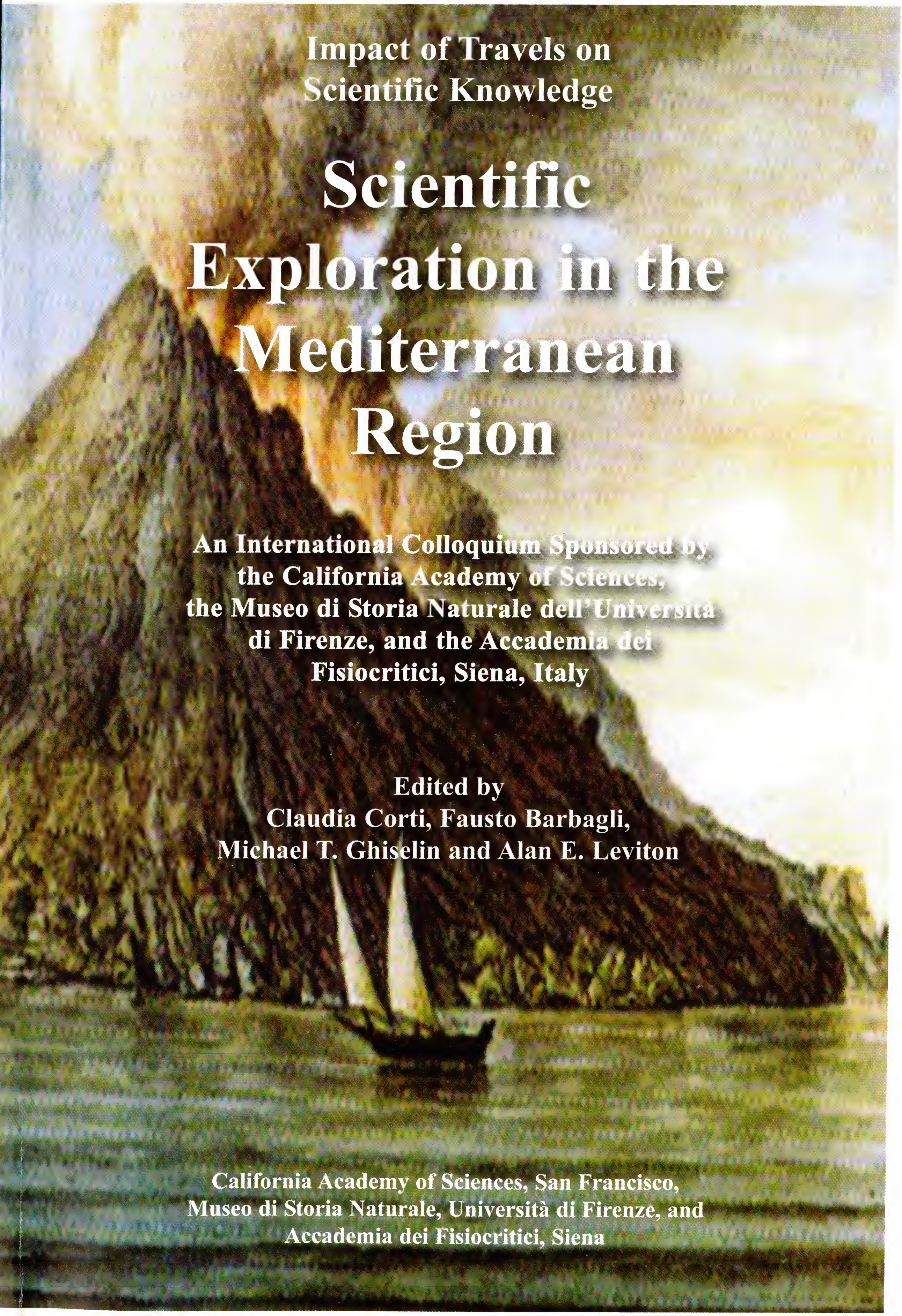

Impact of Travels on Scientific Knowledge

Scientific Exploration in the Mediterranean Region

An International Colloquium Sponsored by the California Academy of Sciences, the Museo di Storia Naturale dell'Università di Firenze, and the Accademia dei Fisiocritici, Siena, Italy

Edited by
Claudia Corti, Fausto Barbagli,
Michael T. Ghiselin and Alan E. Leviton

California Academy of Sciences, San Francisco,
Museo di Storia Naturale, Università di Firenze, and
Accademia dei Fisiocritici, Siena

COVER IMAGE

View of Stromboli drawn by Pietro Fabris (in Hamilton, 1776)
For details see Vaccari, pp. 37–50

Editors' Note

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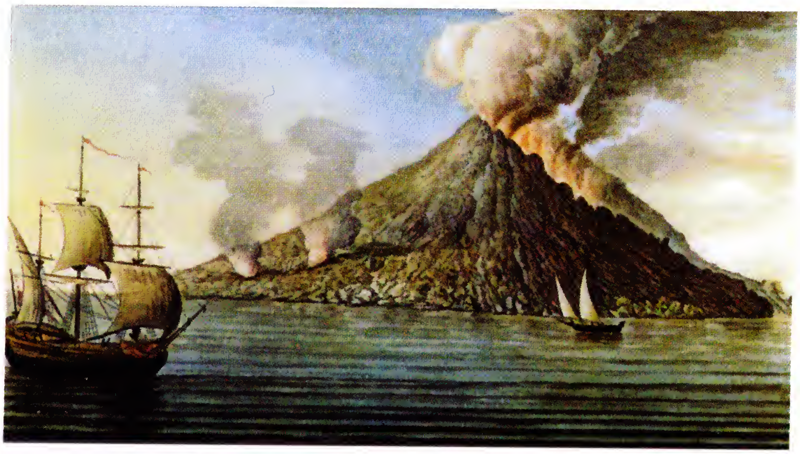
Scientific Exploration in the Mediterranean Region

Cultures and Institutions of Natural History
Essays in the History and Philosophy of Science



Papers presented at an International Colloquium on the
Impact of Scientific Exploration in the Mediterranean Region
held 9–11 November 2006 at the Aula Magna and the Tribuna di Galileo,
Università di Firenze, and the Accademia dei Fisiocritici, Siena

Edited by

Claudia Corti, Fausto Barbagli,
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Museo di Storia Naturale, Università di Firenze,
Accademia dei Fisiocritici, Siena, and the
California Academy of Sciences, San Francisco

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CALIFORNIA ACADEMY OF SCIENCES

VERIS QUOD POSSIT VINCERE FALSA
FISIOCRITICI

Museo di Storia Naturale
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Preface

In 2005, Claudia Corti (Università di Firenze, Italy) met with Michael Ghiselin and Alan Leviton (California Academy of Sciences, San Francisco) in the latter's office at the Academy. In short order, the conversation shifted to a discussion of the successful meeting held in Novara, Italy on the *Impact of Travels on Scientific Knowledge* (*Proc. Calif. Acad. Sci.* 2006, vol. 55, Suppl. II) that had been cosponsored by the Museo di Storia Naturale Faraggiana Ferrandi and the California Academy of Sciences. The three wondered why not a follow-up meeting in Florence that would focus on the Mediterranean inasmuch as a number of people in Italy and the United States were actively engaged in studies on how travels influenced scientific thought in the region. The idea was embraced enthusiastically and work began almost immediately to bring it about. The indomitable Dr. Corti, on her return to her University, found a receptive audience both there and at the nearby Accademia dei Fisiocritici, Siena. She was soon joined by her colleague Fausto Barbagli and received additional encouragement from Drs. Giovanni Pratesi, President of the Museo di Storia Naturale dell'Università degli Studi di Firenze, and Sara Ferri, Presidente dell'Accademia dei Fisiocritici. During the weeks that followed, Drs. Corti and Barbagli together with Dr. Ghiselin contacted colleagues they knew were engaged in interesting studies of the region and a program of considerable breadth and interest quickly emerged, one that attracted participants from several countries and institutions.

The rest is now history. The meeting was held in Florence, Italy, 9-11 November 2006 at the Aula Magna and the Tribuna di Galileo of the Università di Firenze and at the Accademia dei Fisiocritici, Siena. Thereafter, the participants were encouraged to prepare their remarks for publication, and it is with considerable pleasure that we are now able to publish the papers presented during the three-day meeting. At this time, we wish to thank the participants, the organizers, and all those who so warmly welcomed us and to express our hope that this will serve to encourage future collaboration among our institutions and colleagues.

Michael T. Ghiselin and *Alan E. Leviton*
13 June 2008

Participants in the Colloquium on Scientific Exploration in the Mediterranean Region (Front row, left to right) Terry Gosliner, Fausto Barbagli, Michael T. Ghiselin, Claudia Corti, Stefania Lotti, Elisabetta Lori, Marta Poggesi. (Rear row, left to right) Paolo Agnelli, Valentin Pérez-Mellado, Marco Masseti, Agnese Visconti, Sergei Fokin, Carlo Violani, Claudio Pogliano, Juan Lucas Cervera, Pietro Antonio Bernabei, Monica Siviero, Christiane Groeben, Ezio Vaccari, Pierluigi Finotello, Simone Cianfanelli, Annamaria Nistri

Opening concert at the Aula Magna of the University of Florence, given by the Coro Universitario di Firenze, director Valentina Peleggi

Scientific Exploration in the Mediterranean Region
Welcome to Delegates in Florence

Firstly, I wish to express my most sincere thanks to all of you present at the inauguration of this stimulating conference. I feel honoured to present this scientifically and culturally important initiative, which has involved the collaboration of many people and institutions.

Among the organizers, I want to mention the California Academy of Sciences, the Accademia dei Fisiocritici of Siena, and the Museum of Natural History of the University of Florence. I am also pleased to acknowledge the funding of the Doctoral programs in the History of Science of the Universities of Pisa, Siena, and Florence; the APT, the Official Tourist Office of Florence; the Terre di Siena, Official Tourist Office of Siena, and ATAF, the Public Transport Company of Florence.

Moreover, I certainly cannot fail to thank the speakers who, having arrived here after more or less long journeys, will speak in these three days about the journeys and explorations that have characterized the history of the Mediterranean region for over two millennia. Last but not least, allow me to give particular thanks to Dr. Claudia Corti, who has expended a lot of energy organizing this important event.

I don't want speak about all the historical and scientific aspects related to the explorations, because this will be the topic of the various contributions, beginning with my brief greeting. However, I wish to make some brief remarks on the importance that historical research and journeys have for museums.

A group specifically dedicated to this type of research was created two years ago within the Museum of Natural History of the University of Florence; especially in a Museum with a great tradition, this type of research is essential to understand the origins and, in particular, the numerous links that have led, through the centuries, to the formation of such a remarkable patrimony of collections. Well, this group has already manifested excellent scientific and organizational abilities, also through the organization of events like this one, which speaks about history, our history.

It is my view, and I hope one that is shared by many here, that historical research should be considered a moral obligation for museums. This is because museums house collections, and if single specimens speak to us and tell us stories that concern nature, collections recount the stories of the men and women who have collaborated to create them, men and women who, as naturalists, were, and still are, animated by a spirit of adventure that is fully expressed in explorations and voyages. Indeed, as John Steinbeck wrote: "People don't make voyages, voyages make people."

Voyages make people because they help to broaden knowledge, open new horizons, and create networks of interpersonal relationships that are the foundation of each civilization.

Yet voyages and explorations can also be strictly aimed at research and the enrichment of collections. Two faces of the same coin since, especially in the naturalistic disciplines, knowledge can never be separated from nature and natural objects.

And, in a world giving increasing attention to virtual reality, we wish forcefully to call attention back to real reality, to nature, which is not a simple corollary but the essence of our planet.

And it is exactly through explorations of nature that we can today pursue the enrichment of knowledge that distinguishes and characterizes the activity of the scientific community.

To conclude, I wish to quote some essential but effective words of the well-known Lebanese poet, Kahlil Gibran, "Let your adventurous spirit always lead you on ahead to discover the world that surrounds you, with its oddities and its wonders. To discover it will mean for you to love it."

Giovanni Pratesi
President of the Museo di Storia Naturale dell'Università di Firenze

The façade of the Accademia dei Fisiocritici Siena

A gallery of the Museum of Natural History of the Accademia dei Fisiocritici, Siena

Welcome to Delegates in Siena

L'Accademia dei Fisiocritici è ben lieta di accogliere gli studiosi italiani e americani per l'ultima sessione del Convegno "Scientific Exploration in the Mediterraean Region". Un particolare saluto va al prof. Michael T. Ghiselin, zoologo marino e biologo evolutivo che, dall'ottobre dello scorso anno, è accademico onorario della nostra Istituzione.

L'Accademia fu fondata nel 1691 da Pirro Maria Gabbrielli, professore di Medicina Teorica e Botanica nello studio senese. In accordo con l'etimologia greca del nome "fisiocritici" (studiosi della natura), gli Accademici fin dall'inizio si interessarono dello studio dei fenomeni naturali, seguendo le idee illuministiche che andavano diffondendosi in quel periodo.

Per trecento anni l'Accademia è stata una voce importante nelle discussioni tecniche su scienze naturali, medicina, ambiente e agricoltura. Ed anche oggi continua a svolgere la sua funzione culturale mediante conferenze, dibattiti e mostre su vari temi scientifici e, attraverso visite guidate al suo Museo di Storia Naturale, una rilevante attività didattica per i ragazzi.

Il Museo, il cui nucleo originario risale ai primi anni di vita dell'Accademia, oggi possiede, tra l'altro, collezioni geologiche, zoologiche e paleontologiche riferibili prevalentemente alla Toscana meridionale, in quanto le scarse risorse finanziarie dell'Accademia non hanno mai permesso di organizzare spedizioni scientifiche di più ampio respiro. Il Museo, dal 1816 ospitato in un antico monastero, mantiene inalterato il fascino di un allestimento ottocentesco in antiche vetrine.

Rinnovando il benvenuto a Siena e nella nostra Istituzione, auguro buon lavoro a tutti i partecipanti

Sara Ferri
Presidente dell'Accademia dei Fisiocritici

[The Accademia dei Fisiocritici is deighted to welcome the Italian and Americans scholars for the final session of the Conference "Scientific Exploration in the Mediterraean Region". Special greetings are extended to Prof. Michael T. Ghiselin, marine zoologist and evolutionary biologist who, since October of last year, has been an honorary Fellow of our Institution.

The Academy was founded in 1691 by Pirro Maria Gabbrielli, teacher of Theoretical Medicine and Botany in the university. In accord with the Greek etymology of the name "fisiocritici" (scholars of nature), the Academicians from the outset were interested in the investigation of natural phenomenona, following enlightened ideas that were being disseminated in that period.

For three hundred years, the Academy has been an important voice in the technical discussions on natural sciences, medicine, environment and agriculture. Today it continues to develop its cultural function through lectures, debates and exhibitions on varied scientific themes and, through guided tours of its Museum of Natural History, a remarkable didactic activity for the young.

The Museum, whose original nucleus goes back to the first years of life of the Academy, possesses today, in addition, geological, zoological, and paleontological collections. These are mainly from southern Tuscany inasmuch as the scarce financial resources of the Academy have never enabled it to organize scientific expeditions on a wider scale. The Museum, housed since 1816 in an old monastery, retains, unchanged, the charm of a nineteenth century exhibit in antique showcases.

Reiterating the welcome to Siena and our Institution, best wishes and buon lavoro to all of the participants.]

During the meeting at the Tribuna di Galileo, Museo di Storia Naturale dell'Università degli Studi di Firenze, Sezione di Zoologia

Lunch at the "Salone degli Scheletri", Museo di Storia Naturale dell'Università degli Studi di Firenze, Sezione di Zoologia

Introduction

Michael T. Ghiselin[1] and Claudia Corti[2]
[1] *Center for the History and Philosophy of Science, California Academy of Sciences, Golden Gate Park, San Francisco, California 94118; Email: mghiselin@calacademy.org;* [2] *Museo di Storia Naturale dell'Università degli Studi di Firenze, Sezione de Zoologia "La Specola", Via Romana 17, 50125, Firenze, Italia; Email: claudia.corti@unifi.it*

The predecessor of this volume, *Impact of Travels on Scientific Knowledge*,[3] based on an international colloquium held at the Museo di Storia Naturale Faraggiana Ferrandi in Novara, Italy in 2002, considered a wide range of topics having to do with scientific travel. This one is restricted to a particular area. The Mediterranean has been both a center of learning and an object of investigation. Here the science of natural history was born. The rich legacy of Aristotle, Pliny the Elder and other writers of classical antiquity served the basis for modern natural history when it emerged during the Renaissance. At that time, the motivation for studying natural objects was mainly to understand the Greek texts and to provide proper Latin translations of them. Expertise on the Mediterranean flora and fauna was essential to understanding those texts. With the discovery of plants and animals that had not been known to classical authors, natural history took on a life of its own.

In the lyrical essay that begins this volume, Marco Masseti takes us back to even earlier times, when Neolithic and bronze age peoples were exploring the Mediterranean islands by boat. These islands have been home to remarkable faunas and floras, not the least of which are the dwarf elephants, whose fossil remains have become the stuff of legend.

In the time of Cesalpino, Galileo and Vesalius, Italy was home to major centers of scientific investigation. Its universities housed some of the earliest botanical gardens and its aristocracy accumulated important natural history collections and made them available to scientists. Italy did not become a unified national state until late in the nineteenth century, so its museums and other scientific institutions have been products of local government and culture. We are here presented with a case study, the natural history museum of Florence, by the "Gruppo di Riceche Storiche," a team of scholars coordinated by Fausto Barbagli: Giovanna Ciuffi, Marina Clauser, Pietro Cuccuini, Luciana Fantoni, Gianna Innocenti, Chiara Nepi, Daniela Parrini, Marta Poggesi, Luisa Poggi and Monica Zavattaro.

Certain areas in the Mediterranean are centers of volcanic activity. Ezio Vaccari discusses how field work carried out in the eighteenth century enriched our understanding of geological processes and revealed the great amount of time that has been required for major changes to take place. Agnese Visconti provides a case study of Ermenegildo Pini, who explored the coast of southern Italy for the purpose of developing natural history in Milan. Because Pini was a clergyman, it is anything but surprising that there were significant connections between his science and his religion. The Noachian deluge was still being taken very seriously in those days.

The Mediterranean fauna has been extensively studied by zoologists interested in the distribution of particular taxonomic groups of animals. Four chapters are devoted to this aspect of natural history and to the history of such investigation. Earthworms are a good example of a group of animals that do not disperse readily and are particularly useful in working out the sort of biogeographical puzzle that involves changes in the configuration of the earth. Pietro Omodeo and Emilia Rota give us a most instructive example of how such research has been carried out. Reptiles and amphibians have been particularly interesting to students of insular biogeography. Valentin Pérez-Mellado, Claudia Corti, and Josep Miquel Vidal discuss the evolution of our knowledge of the herpetofauna of the Balearic Islands. They relate this history to the development of herpetology as a dis-

cipline. As one might expect, there have been strong linkages to evolutionary theory, and it is pleasing to know what these were. The modernization of herpetology seems to be keeping pace with that of evolutionary biology in general. Birds, of course, are more adept at reaching islands than are earthworms and quadrupeds. They have also been intensively studied by systematists and other biologists. Nicola Baccetti and Joe Sultana provide brief biographical essays on two local ornithologists who studied insular bird faunas.

Five chapters are devoted to the study of marine animals and to the history of marine biology and its institutions. Terrence M. Gosliner, Juan Lucas Cervera, and Michael T. Ghiselin review the history of research on the systematics of Mediterranean opisthobranch gastropods. They contrast the "scientific tourists" with those who worked at universities and at marine laboratories. They provide a survey of recent developments in Spain and suggest historical trends on the basis of a quantitative assessment of publications on the group. The notion of a scientific tourist is developed in an essay by Christiane Groeben. She explains why four cities were particularly attractive to the "tourists." One of these, Naples, became the location for a permanent laboratory — a sort of "hotel" — the Zoological Station founded by Anton Dohrn. That "hotel" has received a great deal of attention from historians. An essay by Michael T. Ghiselin considers the British presence there, especially from the point of view of why British scientists chose to work there rather than elsewhere. Russians had their own laboratory at Villefranche-sur-Mer on the French Riviera. Sergei I. Fokin's essay reveals what a valuable facility it was. Venice was also a major player in marine biology. Sandra Casellato devotes a chapter to marine investigations in the Adriatic up to the present time.

Ending the volume, Giovanni Pinna considers how science is affected by political and economic affairs. The motivations for supporting expeditions and institutions have not always been edifying. We might add that the meetings upon which this series of publications has been based were intended to further international good will, cooperation and friendship.

Acknowledgments

We take this opportunity to thank the following persons for their many contributions to the success of the meeting: Gianna Innocenti, editor of the Abstract volume of the meeting; Daniela Parrini, Secretary's Office, and Alba Scarpellini, Press Office, Museo di Storia Naturale dell'Università degli Studi di Firenze; Maria Cristina Andreani, graphic design; Chiara Bratto, Press Office, Accademia del Fisiocritici, Siena; Rosalba Mulinacci, Ferruccio Farsi, and Fabrizio Cancelli, Accademia del Fisiocritici, Siena; Dottorato di Storia della Scienza dell'Università di Pisa, Siena and Firenze; Ugo Bazzotti and Florenza Guerranti for their interest in the meeting; Agenzia per il Turismo di Firenze, and Agenzia per il Turismo di Siena.

At the California Academy of Sciences, we wish to express our thanks to Hallie Brignall and Michele Aldrich, both of whom read and critiqued all of the papers included in this volume and made numerous suggestions for the improvement of the presentations.

Lastly, we again thank all of those who made this program a reality, and the institutions that made it possible by providing the necessary resources, both for the meetings and the subsequent publication of the symposium itself: the Museo di Storia Naturale dell'Università degli Studi di Firenze, the Accademia dei Fisiocritici, Siena, and the California Academy of Sciences, San Francisco.

Scientific Exploration in the Mediterranean Region

PROCEEDINGS OF THE CALIFORNIA ACADEMY OF SCIENCES
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The Most Ancient Explorations of the Mediterranean

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"*...sailing the wine-dark sea to men of alien language...*"
(Homer, *The Odyssey*, I: 183)

When there were no geographical maps, when the marine routes were still uncertain, the ships unsafe and the oceans wild and dangerous, travelling was an epic endeavour. The explorers of antiquity almost always departed without knowing exactly where they were going, generally heading for exotic seascapes populated in their imagination by fabulous creatures (Fig. 1). The three books of the *Odyssey* between the ninth and the twelfth are considered to be the oldest of the poem. Here Odysseus recounts the vicissitudes of his travels before the council of the Phaeacians, King Alcinous and his wife, Arete. His account embodies perfectly the attitude of the man of the ancient world towards travel and exploration. These are adventures dominated by the Olympic and supernatural, where Odysseus and his companions find themselves tackling the most arduous exploits, in the cavern of Polyphemus, between the rock and the whirlpool of Scylla and Charybdis or before the enchanted palace of Circe. Together with the episodes of the cattle of Helios, the overhanging rocks, the winds of Aeolus and the Sirens, the adventures recounted by Odysseus undoubtedly have disparate origins in folklore and in the most ancient heroic cycles, such as that of the Argonauts (Codino 1974). Nevertheless, the journey that Homer's hero tells the king and queen of the Phaeacians about was undertaken in a relatively recent period, when the main sea routes of the Mediterranean were already known and codified, despite what the king of Ithaca wishes us to believe. Effectively, Homerian critics date the definitive version of the two epic poems — the *Iliad* and the *Odyssey* — to the seventh century BC. The same critics maintain that what are considered the most recent books of the *Odyssey*, in terms of language and style, describe a post-Mycenaean world coinciding with the centuries of darkness of the so-called Dark Age of Greece (1200–800 BC) (*cf.* James 1991). The routes along which Odysseus must have sailed had been mapped out many millennia earlier by intrepid sailors who explored the

FIGURE 1. The image of a striped dolphin, *Stenella ceruleoalba* (Mayen, 1833), in the decoration of a Late Helladic I blade referred to about 1500 BC (Athens, National Museum). This cetacean seems to be the species of dolphin most frequently represented in Aegean Bronze Age art.

Mediterranean in the hope of discovering new natural resources to be exploited and new lands to colonise.

Early Over-water Travels in the Mediterranean Basin

The Mediterranean basin is composed of unique geographical and cultural features. The current diversity of its vegetation and fauna is a result of the interaction of several factors, primarily the multiple biogeographical origins of the species, Quaternary climatic changes, which produced a repeated turnover of biota, and Late Pleistocene-Holocene human-induced modifications of habitat, including hunting and the introduction of exotic species (Masseti 1998 and 2002).

Civilisations have been present continuously in this region for over 10,000 years, modifying entire landscapes, disrupting or destroying the majority of native biocenoses, and introducing many new species. There is possibly no other place in the world that has been so intensively influenced by human activity over a prolonged period. Virtually no ecosystems have been left untouched. More specifically, since pre-Neolithic and early Neolithic times, the human settlers of the Mediterranean basin brought about a radical turnover between ancient and modern faunas and floras, introducing a variety of allochthonous taxa. It now appears sufficiently plausible that, up to the Late Pleistocene-early Holocene, this basin increasingly represented less a barrier than a bridge (Uerpmann 1979; Lewthaite 1987; Binder 1989; Guilaine 1994; Orliac 1997), in a relatively short time promoting and multiplying the circulation of ideas, merchandise, faunal and botanical elements and human groups, which spread into new and different environments and, over time and in different ways, became grafted onto the authochtonous substratum (Masseti and Vianello 1991; Masseti 1998). The available archaeological documentation, based on still quite fragmentary evidence, tends to indicate that the first relocations by sea in the Mediterranean basin were already carried out by Mesolithic hunter-gatherers (Jacobsen 1976; Perlès 1979; Cherry 1981 1990 and 1992; Simmons 1991). Evidence from the islands of Corsica (Camps 1988; Vigne and Desse-Berset 1995), Milos in the Western Cycladic Archipelago (Perlés 1979; Renfrew and Aspinall 1990), possibly Kythnos (Cherry 1979), and Cyprus (Simmons 1988 and 1991) indicate an improved seafaring capability. In fact, from the late Mesolithic onwards, the Mediterranean Sea can be considered as a preferential route for the exploration and subsequent colonisation of its coastlines and islands (*cf.* Payne 1975; Perlés 1979; Shackleton et al. 1984; Fedele 1988; Pennacchioni 1996). Furthermore, inasmuch as the exploitation of natural resources of the Mediterranean basin was an uninterrupted process beginning in prehistoric periods and lasting until historical times, in the vast majority of cases it is impossible to reconstruct the natural ecosystems of the past that have been destroyed, and hence lost for millennia (Masseti 2002b).

Islands are more likely to offer unequivocal evidence of the alterations made by man to the original ecosystems. Indeed, it is on the islands that the impact of extraneous elements on the unspoilt ecological system can be identified and the chronology calculated with considerable precision because of the evidence left and the relative rapidity of the consequences produced. In general, evidence for human activity on the Mediterranean islands prior to the Neolithic is limited (Cherry 1981). This is not to say that the islands had not been previously discovered, or at least previously visited. Evidence from the Franchthi Cave, in the eastern Peloponnese, for example, demonstrates clearly that the island of Milos was exploited as a source of obsidian in Early Mesolithic times (*c.* 13,000 BP) (Perlés 1979 and 2001), but there is no evidence for permanent settlement on this island before the Neolithic (Cherry 1981) (Fig. 2).

It is clear that the movement of a raw material, such as the Milosian obsidian, can only have been accomplished by over-water travel. Thus, this evidence from Franchthi also suggests that Mesolithic human groups in the Mediterranean were capable of undertaking regular, long-distance

sea voyages and of vessels capable of making such crossings (Perlés 1979).

The "true" Mediterranean islands (Vigne 1999), that is those which can be compared to "oceanic islands", are the preferred basis for considerations on prehistoric navigation. Although varying greatly in their geological histories, none of these islands were joined to the nearest land-masses during the regressions of the sea level (between 120 and 150 m) during any of the Pleistocene glacial episodes (Van Andel 1989, 1990). Thus, such marine crossings must have presented real difficulties and involved many days travel. In order to reach these islands, more or less distant, but all visible from the mainland in favourable weather conditions, man had to devise technical expedients, such as the construction of vessels that could be adequately managed over the course of these long sea journeys. As observed by Perlès (2001), many of the crude stone tools of the Aegean Mesolithic hunter-gatherers were in fact used to work the fibres necessary to manufacture nets, baskets, and boats (Vaughan 1990). The latter could have consisted of reed boats, such as the "papyrella", which was reconstructed several years ago and used to collect obsidian from Sounion to Milos (Tzalas 1995). This papyrella, based on a Corfiote's model, proved its seaworthiness, but it also confirmed the need for developed nautical skills, which the intensive fishing of tuna, barracudas and groupers had already suggested (Jacobsen 1993).

FIGURE 2. Located in the Western Cycladic Archipelago, the island of Milos (Greece) was exploited as a source of obsidian in Mesolithic times (*c.* 13,000 BP), but there is no evidence for permanent settlement on this island before the Neolithic.

These considerations are, however, based solely on an indirect approach to the prehistoric navigation of the Mediterranean inasmuch as underwater archaeology has not yet discovered any vessels dating to before the Bronze Age. The most ancient vessel known to date is the wreck of *Dokos* (Saronic Gulf), dating to the Early Helladic (2500 BC) (Papathanassopoulos 1977), whereas possibly the most famous is the wreck of *Uluburun* dating to the Late Bronze Age (1300 BC) (Bass *et al.* 1989; Pulak 1996 and 1997). The collections of the Goulandris Museum of Athens also comprise a Minoan fictile model of a vessel, referred to approximately 2160/1970–1700/1650 BC (Mitsotakis Coll. cat. no 91) (Fig. 3). There are also several known exemplars of Mesolithic pirogues in northern Europe and in temperate Europe (see for example Mordant and Mordant 1992), but the only tangible evidence of Neolithic vessels are the monoxyle boat of Bercy (5th millennium BC), the two models reproduced in terracotta, the monoxyle pirogue of the Lake of Bracciano, close to Rome (Fugazzola Delpino and Mineo 1995), and the rare finds of the Spanish site of La Draga (5th millennium) (Bosch y Lloret, Chinchilla Sanchez, and Tarrus y Galter 2000). Despite its undeniable value for a knowledge of river and lake navigation and its potential for cultural exchange, nevertheless this documentation does not provide a clear account of Neolithic techniques of naval construction.

FIGURE 3: The collections of the Goulandris Museum of Athens also comprise a Minoan fictile model of a vessel, from early 2nd millennium BC (Mitsotakis Coll. cat. no 91).

The existence of authentic vessels sailing the open sea, however, emerged clearly in

many parts of the world in the wake of the late Palaeolithic. According to the most ancient archaeological evidence, the human presence in Australia dates to over 40,000 years ago (Vinton Kirch 1997; Allen et al. 1998; Johnstone 1988; Bowler et al. 2003). On the other hand, it would appear that the fishermen and hunter-gatherers of the Mediterranean demonstrated a tendency towards maritime navigation much later (Cucchi and Vigne 2006). Recent research into the pre-Neolithic populations of the large islands of the Mediterranean has demonstrated that most of the islands were not explored until around the ninth millennium BC (Vigne 2000). Apart from the case of the Milosian obsidian found at Franchthi, the most ancient documented pre-Neolithic human presence is represented by the site of Akrotiri-*Aetokremnos* in Cyprus, dating to around the end of the tenth millennium BC (Simmons 1991 and 1999). This is followed by that of Corsica and Sardinia, both of which were explored at about the same time, around the eighth millennium BC (Masseti and Vianello 1991; Vigne and Desse-Berset 1995; Tozzi 1996; Vigne et al. 1996). This first phase in the conquest of the islands was implemented by small groups of nomadic hunter-gatherers (Mesolithic) who frequented the coasts of the islands in the course of seasonal forays (Masseti and Darlas 1999; Costa et al. 2003).

Late Quaternary Island Ecosystems and Man

"A sea change into something rich and strange. What potions have I drunk of Syren tears?"
(W. Shakespeare, *Sonnet* 119)

Now, let's attempt to penetrate the densely tangled vegetation of the jungles of endemic evergreen oaks that must have covered most of the "true" Mediterranean islands before any explorer set foot on them (Fig. 4). The atmosphere is worthy of the opening of the most exciting adventure story. Breathing the salty tang of the breeze rolling in off the sea, its surface as smooth as a pane of diaphanous glass, we cannot resist the desire to probe with the eyes of the imagination the lush vegetation that cloaks the island hills, seeking to imagine the secret lair of aberrant beasts, and monstrous, primitive and immortal creatures. Thus what comes to mind is the ancestral memory of the totemic god, of the primordial unconscious archetype relegated, since time immemorial, to the most isolated and lonely place in the world and to the innermost depths of our being. The "true" islands of the Mediterranean were inhabited by extraordinary creatures that could have proved to be intriguing aberrations from what we would have expected of our ancestors.

In some respects, in the light of palaeontological and zooarchaeological evidence, late Quaternary island ecosystems were in fact quite different from adjacent continental ecosystems: the existence of endemic animal species is perhaps the most obvious example of this. Several of the fossil faunas of the Mediterranean islands differed considerably from contemporary continental faunas and were characterised by a very low taxonomic diversity. Examples from the Balearics, Corsica and Sardinia, the Tuscan Archipelago, Sicily, Malta, Crete, many Aegean islands, and Cyprus are significant (Fig. 5). Each of these mammalian compositions, even though they were represented by only a few taxa, were repeated (monotonously) on most of the islands. Nevertheless, they displayed peculiar endemic elements that differed greatly from one island to another.

The most common trends of endemisation are the decrease in the size of macromammals, such as proboscideans and artiodactyls, and the increase in the size of micromammals, such as insectivores and rodents. These modifications are generally assumed to be primarily a consequence of the genetic isolation from continental populations, a quantitative and qualitative reduction in food supply, alteration of intraspecific competition, the absence of large carnivores and, in so far as the micromammals are concerned, endothermic adaptations (Masseti and Mazza 1996). They may in fact be the necessary result of a tendency towards a redefinition of ecological equilibria under very

peculiar environmental conditions (*cf.* MacArthur and Wilson 1967; Blondel and Vigne 1993). The endemisation of island faunas is in fact the result of a normal and repetitive reorganisation of a few, unbalanced faunal entities distributed in restricted areas with limited resources (Masseti and Mazza 1996). The majority of the endemic oligotypic associations and/or single species provided by the Mediterranean islands apparently vanished prior to any evidence of permanent human occupation (Masseti and Darlas 1999). Most of the islands were not occupied by hunter-gatherer groups, though this is not to say that the islands had not already been discovered. On the island of Kythnos in the Western Cyclades, for example, no details have emerged about any possible cultural association for a ^{14}C-dated Pleistocene fossil dwarf elephant site. The same is true of the Charkadio Cave on the island of Tilos (Dodecanese), where the age of the deposits containing dwarf elephant remains ranges from very late Pleistocene to early Holocene (Theodorou 1983; Bachmayer et al. 1984).

On the other hand, as already observed, only on the island of Cyprus have the excavations of the oldest site of Akrotiri-*Aetokremnos* brought to light the clear conjunction of cultural material and huge quantities of bone from the extinct endemic fauna (Simmons 1988, 1989, 1991). Associated with this site is a huge faunal assemblage, which consists of endemic mammalian species thought to have become extinct during the Pleistocene, prior to the arrival of humans on the island. From this Cypriot faunal assemblage over 250,000 pieces of bone have been retrieved. About 95% of the osteological material is referable to the endemic pygmy hippopotamus, *Phanorious minor* (Desharest, 1822) (Simmons 1991), that was even smaller and more slender than the extant Liberian hippo, *Hexaprotodon liberiensis* (Morton, 1849) (Boekschoten and Sondaar 1972) (Fig. 6). Simmons (1991) estimates that a minimum of 200 individuals of this taxon were represented among the fossil remains of *Aetokremnos*. And, although approximately 20% of the

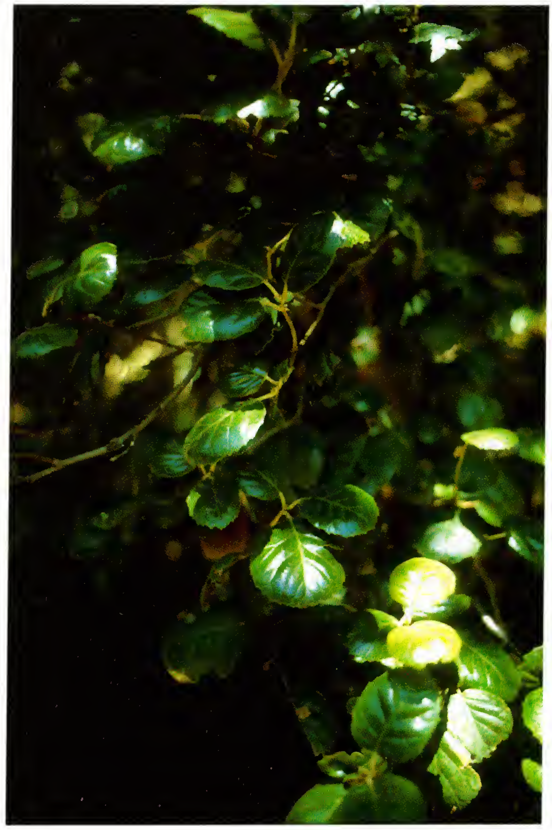

FIGURE 4: Dense jungles of the evergreen endemic golden oak, *Quercus alnifolia* Poech, 1842, must have occurred on the island of Cyprus before any explorer set foot on it (photo Marco Masseti).

FIGURE 5: The archaeological exploration of cave sites on the island of Majorca (Balearic Islands, Spain) provided several remains of an endemic, highly specialised caprine, *Myotragus balearicus* Bate, 1909, which survived until the time of the importation of livestock from abroad (courtesy Museo Arqueológico Nacional, Madrid).

bone was burned and almost none articulated, yet no clearly butchered bone was identified (Simmons 1991). Hippopotami were no by means the only item reported from the site. The pygmy endemic elephant, *Elephas cypriotes* Bate 1903, was also represented by at least three sub-adult individuals. Over 20,000 individual marine invertebrates were also recovered. Additionally, a variety of birds and limited amounts of fish and reptile remains were represented (Simmons 1991).

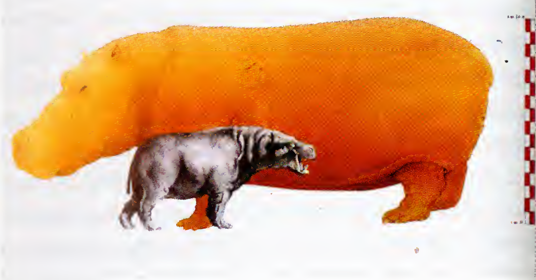

FIGURE 6. Artist's reconstruction of the extinct pygmy hippopotamus *Phanorious minor* (Desmarest, 1822) of Late Pleistocene Cyprus, adapted from the specimen in the London Natural History Museum and compared to the size of the extant *Hippopotamus amphibius* L., 1758 (drawing by Alessandro Mangione and Marco Masseti).

The assemblage of chipped stone artefacts of Akrotiri could generally fit within either Natufian or early pre-pottery Neolithic contexts from the Levant (Simmons 1991). A consistent group of a dozen ^{14}C dates (shell, bone, charcoal), arguing in favour of an 11th millennium b.p. occupation, with a weighted average of 10,030 ± 35 BP, sets the findings of Akrotiri-*Aetokremnos* only a few centuries before the earliest record now available for the pre-pottery Neolithic period, recently discovered at Shillourokambos and dated to the first half of the end of the 9th millennium (see Guilane et al. 1996, 2000; Briois et al. 1997). However, that of Akrotiri appears to represent a relatively short-lived occupation, and there is certainly no evidence for continuity between the hunter-gatherer and the successive pre-pottery Neolithic cultural contexts (Cherry 1992). Akrotiri-*Aetokremnos* has implications for early seafaring technology and, more importantly, for the adaptive strategies practised by these early Mediterranean colonists. In fact, Cyprus has never been connected to the mainland (Hadjisterkotis and Masala 1995), so human settlement must have taken place through the use of relatively efficient seafaring craft. Equally interesting is the association of cultural materials with extinct late Pleistocene vertebrates. *Aetokremnos* appears, in fact, to represent one of the few good examples of a late Pleistocene/early Holocene cultural adaptation directly associated with the extinction of an endemic vertebrate fauna. In the light of all this, Cyprus is the first Mediterranean island where some of the endemic vertebrates do appear to have been wiped out by human hunting.

As we have seen, maritime technology and navigation knowledge were probably not significant barriers to the exploration of the Mediterranean islands by early Mesolithic human groups, but there is no evidence for permanent settlement before the early Neolithic. On Crete too, and on other islands, there is no convincing evidence for pre-Neolithic human settlement, though negative evidence is not conclusive. The endemic animals of these islands are believed to have been largely rendered extinct between the end of the Pleistocene and the advent of human colonisation (Lax and Strasser 1992). But any overlap between the endemic Pleistocene fauna of Crete and human occupation of the island cannot be supported by archaeological data, despite considerable efforts to uncover a pre-Neolithic occupation (Cherry 1992; Patton 1996). According to the 'theory of island biogeography', outlined by MacArthur and Wilson (1967), island environments should be characterised by reduced biodiversity, to which animal populations, like human communities, would have to adapt. Thus, it has been suggested that the extinction of the insular endemics may have been more related to their inability to adapt further in the face of a basically unfavourable environment than to the hunting abilities of pre-Neolithic man. In any case, this is probably more true of small and remote islets than of islands such as Crete or Cyprus, still characterised by a great variety of natural resources. In the light of the archaeological evidence, therefore, one might conclude that

the impact of hunter-gatherer communities on the ecology of Mediterranean islands appears to have been relatively limited. Nevertheless, as hypothesised by Rackham and Moody (1996), if Early Mesolithic voyages to Milos for obsidian were combined with hunting trips to Crete or to other islands, most of the endemic mammals could have disappeared before there was any settlement that left an archaeological record (Masseti and Darlas 1999).

Neolithic Navigation

The earliest important navigation in the Mediterranean must undeniably have commenced in the Neolithic period, because, apart from the Balearics (Schüle 1993; Ramis et al. 2002; Alcover 2004), this was the era in which the Mediterranean islands were truly colonised and populated (Cherry 1990; Camps 1998; Vigne 1999). The island of Cyprus was the first to be colonised by a peasant community at the end of the ninth millennium BC (Guilaine et al. 2000; Peltenburg et al. 2000; Guilaine and Le Brun 2003). The Neolithic settlement of the islands cannot be explained as the result of a merely casual maritime dispersal of the hunter-gatherers but appears much more plausibly a movement of intentional and planned colonisation (Perlès 2001). The cases of the Neolithic settlement of Crete and Cyprus support this hypothesis. In both cases the colonisation was accompanied by the transfer of the continental ecological appurtenances, made up of cultivars and domestic animals, the wild progenitors of which did not exist on the islands (Broodbank and Strasser 1991; Masseti 1998; Vigne and Buitenhuis 1999; Willcox 2001). Therefore, it is not simply a question of the transfer of knowledge of agricultural practices and breeding, but also of the physical transportation of the animals themselves. The human group and the related domestic animals that were moved by sea had to be sufficiently important and balanced to establish a vital population of men and beasts so that the agrarian way of life could be reproduced in a new territory. This ecological and cultural transplantation could not have been the result of casual maritime prospecting but only the outcome of an expedition, or a series of expeditions, planned and prepared with a specific objective, the colonisation of an island.

The colonisation of insular environments in the Neolithic could be set in relation to a radical change in naval technology. If we assume that this took place in one voyage, the Neolithic colonisation of an island such as Crete would have demanded a founding event involving a significant human group (about forty individuals) and a load amounting to several tons in weight (animals, reserves of grain, drinking water, etc) (Broodbank and Strasser 1991). Migratory phenomena of this kind imply a change in the construction techniques of the vessels. The craft used by the societies of hunter-gatherers of the late Palaeolithic are known to have been light, manageable, and easy to transport (Johnstone 1988), whereas the vessels of the Neolithic colonies must have been considerably larger and with a greater draught. The Neolithic colonists introduced not only domestic livestock (goats, sheep, oxen, pigs) onto various islands, but also game (red deer, fallow deer, hares and foxes) for hunting, always an activity of considerable importance in Neolithic societies (Masseti 1998; Vigne et al. 2000). Whatever the status (wild, tamed or domestic) of the animals introduced, they were certainly embarked live (*cf.* Masseti 1998). For this purpose, it is highly probable that the Neolithic colonists selected young exemplars rather than adults, considering that a pair of reproducing adult bovines has an average weight of 1200 kg. Therefore, the Neolithicisation of the large Mediterranean islands, such as Cyprus, Crete, or Corsica, most likely entailed the construction of much larger vessels (3 or 4 metres long) and with a greater draught than the Mesolithic pirogues (Vigne and Cucchi 2005).

An Image of North Africa from the 2nd Millennium BC

We have seen how the contacts among the human populations of the Mediterranean basin commenced in very ancient times. This is a phenomenon that is well documented, on an archaeological basis, for the Neolithic chronologies, but it appears more evanescent and discontinuous for the Chalcolithic period and that of the Early Bronze Age. Later, in the Late Aegean Bronze Age, we can observe a veritable mercantile hegemony of this culture in the eastern Mediterranean. Minoan centres were active on Crete, Santorini, Rhodes, and Cyprus (Karageorghis and Stampolidis 1997; Marketou 1998, 2006; Stampolidis *et al.* 1998; Niemeier 1998), and luxury commodities were regularly traded between the opposite shores of the eastern Mediterranean basin: among the southern Balkan Peninsula, Egypt, the Levant and Asia Minor (*cf.* Vivian Davies and Schofield 1995; Masseti 2003a, 2003b). From the 16th century on there was also a systematic, regular and organised frequentation of the western Mediterranean by sailors of Mycenaean culture originating from the Aegean area.

However, the first accounts of the most ancient Mediterranean explorations did not emerge until the Middle and Late Bronze Age. In most cases these were not written documents, such as the contemporary reports of the Egyptian expeditions conducted to the south of the first cataract, in the Red Sea, or in search of the legendary land of Punt, but were rather artistic representations. Possibly the most ancient of such reports is that comprised in the decoration of the wall-paintings of the so-called West House (Ditike Oikia) of the prehistoric settlement of Akrotiri, on the island of Santorini (Aegean Sea, Greece). The artefact has been dated in the first half of the 2nd millennium, because the eruption of the island is considered to have occurred around 1645 BC. (Hammer et al. 1987). As noted by various authors (Cameron 1968, Masseti 1980, 1984, 1997, 2000, 2003a; Marinatos 1984 and 1987; Immerwahr 1990; Vanschoonwinkel 1990 and 1996; Doumas 1992; Yannouli and Trantalidou 1999; Trantalidou 2000), the naturalistic illustrations of the Aegean landscape by the local artists of the 2nd millennium BC are a form of realistic representation, portraying certain aspects of the natural environment that were familiar to the painters. Other artistic productions of the Aegean Bronze Age culture, however, provide a different perception of natural subjects, which have been depicted as if the artist did not have sufficient knowledge of the scenes he was asked to portray by his patrons (Masseti, 2000 and 2003c). This may be the case of the illustrations of exotic habitats extraneous to the ancient Aegean natural world of the so-called "West House" miniature. In fact, these images constitute a miniature frieze portraying the glory of Minoan sea power, with scenes of sea-faring, towns, battles, and exotic landscapes (Athens, National Museum) (Televantou 1990; Doumas 1992). According to one interpretation, warships attended by sporting dolphins sail in triumph past what is thought to be the Libyan coast of Africa (*cf.* Marinatos 1974; Stucchi 1976). In fact, the subtropical landscape depicted in this scene is characterised by elements unusual to the natural environment of the South-Aegean islands. In a riparian setting with palms and other exotic trees, aquatic birds, and wild mammals are depicted in the eternal struggle for survival. The scene does not include humans. Part of the picture is dedicated to the representation of a spotted carnivore stalking a pair of aquatic birds, described by Marinatos (1974) as "ibis or flamingo" on account of their curved beaks (Fig. 7). Doumas (1992) identified them as wild ducks. The two birds, together with another in flight further to the left, share the form of the family Anatidae, but look more like geese than ducks. These goose-like birds have a long neck, short legs and squat body, and might resemble Egyptian geese, *Alopochen aegyptiacus* (L. 1766). On taxonomical grounds, however, it is impossible to refer them to any precise genus or species, because of the morphological inaccuracy of their representation. The same unrealistic mode of depiction also characterises the stalking carnivore, which might be generically referred to

FIGURE 7. Detail of the "North-African landscape" from the miniature frieze of the so-called "West House", Akrotiri (island of Santorini, Greece) (Late Minoan IA, about 1550 B.C., Athens, National Museum) (from Doumas 1992).

a felid species of unknown identification. It can be assumed that, rather than portraits of biological elements known to the artists, both the depicted birds and the spotted carnivore represent free elaborations of iconographic models that were perhaps not of Aegean Bronze Age origin (Masseti 1997). This scene appears to derive its inspiration from model books of contemporary Egyptian art, where wetland hunting scenes were a popular painting theme (*cf.* Vanschoonwinkel 1990). Effectively, there is evidence of cultural contacts between Egypt and the Minoan world since the Cretan pre-palatial Early Bronze Age and the Egyptian Early Dynastic, Old Kingdom and First Intermediate Period (*c.* 3000–1900 BC) (Bietak 1995; Warren 1995). Among the principal examples of this Egyptian iconographic tradition, we might mention the wall-paintings in the tomb of Khnumhotep III at Beni Hasan (*c.* 1900 BC), or from the Theban tomb of Nebamun (*c.* 1450 BC, London, British Museum). Iconographic elements imported from Egypt also probably inform other Minoan artistic productions, such as the decoration of the dagger blade inlaid with a "Nilotic scene" from the Mycenae shaft grave V, which is also considered a Cretan work (Late Minoan IA, c. 1550–1500 BC, Athens, National Museum). Whatever its source of inspiration, the "subtropical landscape" of the Theran "West House" miniature appears to portray a natural environment completely unknown to the Minoan artist, who reproduced the exotic North-African landscape purely on the basis of descriptions made by visitors, integrated into his work through iconographic expedients taken from the foreign artistic tradition (Masseti 1997).

The Wanderings of Odysseus. Concluding Remarks

"Then you will reach the island Thrinakria, where are pastured the cattle and the fat sheep of the sun god, Helios, seven herds of oxen, and as many beautiful sheepflocks, and fifty to each herd. There is no giving birth among them, nor do they ever die away, and their shepherdesses are gods, nymphs with sweet hair..."
(Homer, *The Odyssey*, XII: 130)

Effectively, from the Chalcolithic and the Aegean Early Bronze Age the first legendary references of the Greek literary tradition are backed up by material archaeological evidence (De Juliis

1998). Thus, having seen the very ancient beginnings of the exploration of the Mediterranean by the first human groups — as documented to date — we can now return to consider the wanderings of Odysseus from which we started at the beginning of this paper. We left Odysseus in the palace of the king of the Phaeacians, recounting all his adventures — the Lotus eaters, the Cyclops, the descent to the underworld and the rest — in a sort of sacred interval of recreation, of incipient reintegration into the world of men (*cf.* Kirk 1980). In this way, Homer casts around a dense web of information that appears to indicate that the hero has gone beyond the confines of the real world (Heubeck 1981). Apropos this aspect, the world of Odysseus' wanderings has generated considerable controversy (Lattimore 1991), leading to the adoption of two diametric standpoints. One view holds that places such as the land of the Lotus eaters, the isle of Circe, Scheria (the home of the Phaeacians), and so forth, may represent real places in the Mediterranean, or beyond, or at least some of them may. The other maintains that all such places are imaginary. Both views appear to be extreme, but it is difficult to find a middle ground. There is, for example, a strong and apparently early tradition that places Polyphemos and the Cyclops in Sicily. Writing at the end of the fifth century BC, Thucydides, one of the most important historians of classical antiquity, also refers to legends about Cyclops. But, nothing in the text of the *Odyssey* indicates that the Cyclops lived in Sicily or, in fact, on an island at all (Lattimore 1991). This poem, as it has come down to us, could not have been completed much before the end of the eight century BC. The traditional foundation dates for many Greek cities in the western world are earlier than that. Sicilian Naxos is said to have been settled in 735 B.C., Syracuse and Korkyra in 734, and half a dozen others before 700. Nor should we forget that the earliest frequentation of these territories by peoples of Helladic origin — Mycenaeans — is, as we have seen, documented starting from the 16th century BC (*cf.* De Juliis 1998). Thus, by the time of the completion of the *Odyssey*, the western Mediterranean as far as Sicily was not only well explored, but pretty well settled with Greek colonies, colonies just as Hellenic, or almost, as their parent cities in ancient Greece. How could such a place belong simultaneously to the known world and the wondrous world of Odysseus's wanderings? Only, one might say, by embedding features conceived very early in the process of accumulation and ignoring later phases (Lattimore 1991). The wanderings of Odysseus are a brilliant series of adventures linked and fused by characters. They are nothing more than combinations. They are made by the imagination, and are in part sheer fancy. Sailors' stories can involve monsters and enchanted places, as well as authentic reports, and probably contain bits and pieces of solid unassimilated facts. There is some evidence, for example, that could to some extent support a Sicilian geographic origin for the myth of the Cyclops. The legendary belief that these monstrous creatures inhabited the caves of eastern Sicily could have been generated by certain real circumstances. In fact, when around the 8th century BC (Buchner 1994) the first Greek colonisers reached Sicily and began to set up permanent settlements there, the endemic dwarf mammals had already been extinct for a long time, but the osteological remains were still to be found in the caves, often easily accessible. The remains of the elephants must have attracted even greater interest than the others, favouring the birth of the legends about the Cyclops (Azzaroli 1971). The rear limb bones were in fact easily mistaken for *ossa di giganti* (= "the bones of giants"). But what must have been even more amazing to the first Aegean explorers of Sicily were the other anatomical portions of these proboscideans. In the cranium, in fact, the large hollow of the nostrils set in the middle of the forehead was mistaken for an orbit. In elephants, the true orbits are broadly open at the sides and communicate with the temporal fossa, and probably passed practically unobserved. It's not difficult to imagine how the presence of the broad cavity of the nostrils could have been at the origin of the invention of the monstrous offspring of the sea god, Poseidon, provided with a single eye set in the middle of the forehead (Masseti 1992). These legends about the giants persisted at length. Many centuries later, the Italian poet Gio-

vanni Boccaccio, for example, referred to having seen two teeth and several bones of a "giant" in a church in Erice (Trapani) (*cf.* Azzaroli 1971; Mannino 2002). Very similar was the name used in 1647, at the start of the palaeontological exploration of the Mediterranean islands, by Giovanni Francesco Abela, archaeologist and commander of the Knights of Malta, to refer to the large bones of four-legged creatures he had discovered on Malta: "*Ma finalmente, che maggior testimonianza possiamo noi desiderare nell'habitazione qui de'Ciclopi, senza bisogno d'andarla, mendicando dalle autorità de' Scrittori antichi, involte nell'oscurità dei tempi, che quella ne rendano l'ossa Gigantee ritrovate in Malta, e i sepolcri loro cavati e intagliati nella rocca viva, che ben spesso si scoprono di smisurata grandezza...*" ("But finally, what greater evidence could we desire of the fact that the Cyclops lived here, without having to go and seek it out from the authorities of the ancient writers, shrouded in the mystery of time, than that of the gigantic bones discovered in Malta, and the sepulchres themselves carved and hewn out of the living rock, which are frequently discovered to be of an immense size...") (Abela 1647. *Libro II. De Vari Nomi dell'Isola e de' sui primi Abitatori. Notizia I*: 147–148). It seems that dwarf elephants became extinct on Malta and Sicily many thousands of years ago (Symeonidis and Theodorou 1981; Bada et al. 1991; Masseti 1993; Burgio 1997). But some proboscideans of small size survived on other of the Mediterranean islands up to much later times. As already noted, in the particular case of Tilos, in the Dodecanese Archipelago (Eastern Aegean Sea), the upper levels of the cave of Charkadio, located approximately in the centre of the island, provided a number of dwarf elephant remains (Fig. 8). These animals have been described by Symeonidis et al. (1973), and Theodorou (1983 and 1988) as belonging to the genus *Elephas* — the same as the extant Asiatic proboscidean — but are still specifically unnamed (Alcover et al. 1998). Recently, skeletal remains have been used for DNA analysis, also revealing a relationship to recent Asiatic elephants (Theodorou and Symeonidis 2001). Previously referred to as two distinct forms, the Tilian elephants are now considered as belonging to a single species with marked dimorphism. This form, however, has been only recently specifically described as *Elephas tiliensis* by Theodorou, Symeonidis, and Stathopoulou (2007), previously described from Sicily and Malta (Vaufrey 1929; Ambrosetti 1968). The proboscidean of Tilos is slightly larger than the Sicilian pygmy elephant, whilst the age of the deposits of the discovery site range from the very late Pleistocene to the Holocene (Symeonidis et al. 1973; Bachmayer and Symeonidis 1975; Bachmayer et al. 1976; Dermitzakis and Sondaar 1978; Theodorou 1983, 1988). Two dates were in fact obtained through the radio-carbon dating of the elephant bones. Surprisingly, some of these remains are considered to be very recent, between 7.090 ± 680 and 4.390 ± 600 bp (Bachmayer and Symeonidis 1975; Bachmayer et al. 1976). According to Symeonidis (1972) and Theodorou and Agiadi (2001), it appears that the species first appeared in the sediment of the Charkadio Cave about 45,000 years BP and became extinct almost 4,000–3,500 years ago. Relating to different parts of the cave, the more recent of these datings appear to prove the simultaneous existence of the Tilian elephants and post-Palaeolithic man (Bachmayer and Symeonidis 1975; Bachmayer et al. 1976,

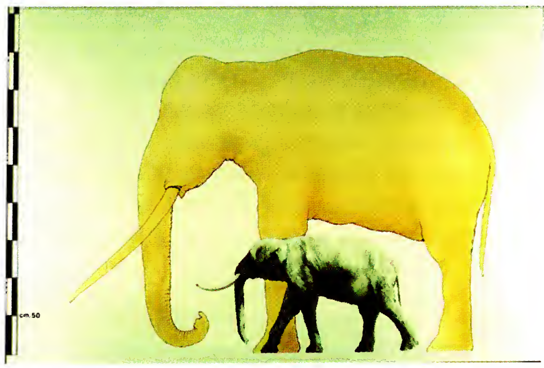

FIGURE 8. Artist's reconstruction of the extinct dwarf elephant, *Elephas tiliensis* Theodorou, Symeonidis, and Stathopoulou, 2007, of Late Pleistocene-Holocene Tilos, adapted from the osteological material in the Museum of Megalochorio (Tilos, Greece), and compared to the size of its supposed ancestor *E. antiquus* Falconer and Cautley, 1847 (drawing by Alessando Mangione and Marco Masseti).

Bachmayer et al. 1984; Theodorou and Symeonidis, 2001). Furthermore, if such dating is reliable, we can presume that this taxon survived at least until the Late Aegean Bronze Age, when a dwarf elephant may have been exported to Egypt as a costly gift for the pharaoh (Masseti 2001). This is not to say that the live pygmy proboscidean depicted in the tomb of Rekh-mi-Re, vizier of Thutmosis III and Amenhotep II (from about 1470 to 1445 BC) at Thebes (Egypt), is definitely the portrait of a Tilos elephant that was actually captured by the Aegean Bronze Age rulers of the island (Fig. 9). It may, instead, have been a dwarf representative of the genus *Elephas* which survived on some Eastern Mediterranean islands during the period of Minoan-Mycenean control (Masseti 2001 and 2003a).

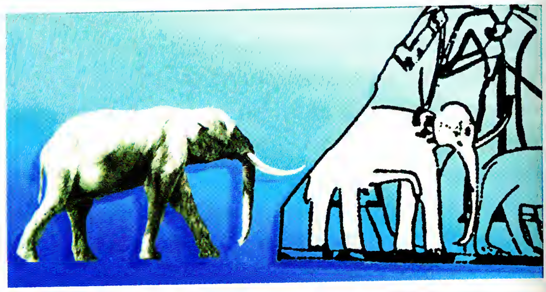

FIGURE 9. The ideal reconstruction of the extinct Tilian elephant compared to the detail of the wall-paintings of the 18th Egyptian Dynasty tomb of Rekh-mi-Re at Thebes, showing a small-sized elephant borne by the Syrian tributaries (drawings by Alessando Mangione and Marco Masseti).

To return to the journey of Odysseus: according to Lattimore (1991), the lands of the wanderings of the lord of Ithaca appear to have a similar status to their inhabitants. They too are of this world and of human stature, rather than of Olympus and the Olympians. Yet they are not quite of this world either. They are people with attributes unlike any people we shall ever meet, and as suggested by Strabo (*Geography* i.2.15), live in places where, after Odysseus, no one will ever go. Hence we can understand how the "Land of the Dead" is described not as an underworld but as a far shore, with certain landmarks possibly borrowed from actual places in the real Mediterranean world.

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REFERENCES

ABELA, G.F. 1647. Della Descrittione di Malta Isola nel Mare Siciliano, con le sue antichità, ed altre notizie. *Libro I. Della Fertilità di Malta. Notizia XII*: 134, Malta. Ms. n. cat. 664.e.1. British Library, London, UK.

ALCOVER, J.A. 2004. Disentangling the Balearic first settlement issues. *Endins* 26:143–156.

ALCOVER, J.A., X. CAMPILLO, M. MACIAS, AND A. SANS. 1998. Mammal Species of the World: Additional data on Insular Mammals. *American Museum Novitates* (3248):1–29.

ALLEN, J., C. GOLDEN, R. JONES, AND J.P. WHITE. 1998. Pleistocene dates for the human occupation of New Ireland, Melanesia. *Nature* 331:707–709.

AMBROSETTI, P. 1968. The Pleistocene dwarf elephants of Spinagallo (Siracusa, South-Eastern Sicily). *Geologica Romana* 1:217–229.

AZZAROLI, A. 1971. Il significato delle faune insulari quaternarie. *Le Scienz* 30:66–75.

BACHMAYER, F., AND N. SYMEONIDIS. 1975. Eigenartige Abspaltungen von Stosszähnen der Zwergelefanten aus der Höhle "Charkadio" auf der Insel Tilos — Artefakte?. *Annales géologiques des pays hélleniques* 26:320–323.

BACHMAYER, F., N. SYMEONIDIS, R. SEEMAN, AND H. ZAPFE. 1976. Die Ausgrabungen in der Zwergelefanten "Charkadio" auf der Insel Tilos (Dodekanes, Griechenland) in den Jahren 1974 und 1975. *Annales des Naturhistorischen Museum Wien* 80:113–144.

BACHMAYER, F., N. SYMEONIDIS, AND H. ZAPFE. 1984. Die Ausgrabungen in der Zwergelefantenhöhle der Insel Tilos (Dodekanes, Griechenland) in Jahr 1983. *Sitzungen Österreichische Akademie der Wissenschaften, Mathematik -naturwissenschaften Klasse*, Abt. 1, 193(6–10):321–328.

BADA, J.L., G. BELLUOMINI, L. BONFIGLIO, M. BRANCA, E. BURGIO, AND L. DELITALA. 1991. Isoleucine epimerization ages of Quaternari mammals from Sicily. *Il Quaternario* 4 (1a):49–54.

BASS, G.F., C. PULAK, D. COLLON, AND J. WEINSTEIN. 1989. The Bronze Age shipwreck at Ulu Burun: 1986 campaign. *American Journal of Archaeology* 93:1–29.

BIETAK, M. 1995. Connections between Egypt and the Minoan world. New results from Tell El-Dab'a/Avaris. Pages 19–28 *in* W. Vivian Davies and L. Schofield, eds., *Egypt, the Aegean and the Levant. Interconnections in the Second Millennium BC*. British Museum Press, London, UK.

BINDER, D. 1989. Aspects de la néolithisation dans les aires padane, provençale et ligure. Pages 199–226 *in* O. Aurenche and J. Cauvin, eds., *Néolithisation*. British Archaeological Report, International Series, no. 516.

BLONDEL, J., AND J.-D. VIGNE. 1993. Space, time, and man as determinants of diversity of birds and mammals in the Mediterranean region Pages 135–146 *in* R.E. Ricklefs and D. Schluter, eds., *Species Diversity in Ecological Communities*. The University of Chicago Press, Chigaco, Illinois, USA and London, UK.

BOEKSCHOTEN, G.J., AND P.J. SONDAAR. 1972. On the fossil mammalia of Cyprus. *Koninklijke Nederlandse Akademie Wetenschappen. Proceedings*, Ser. B, 75:306–338.

BOSCH I LLORET, A., J. CHINCHILLA SANCHEZ, AND J. TARRUS I GALTER, EDS. 2000. *El Poblat lacustre neolitic de La Draga: excavacions de 1900 a 1998*. Monografies del GASC edition. Museu d'arqueologia de Catalunya, Centre d'arqueologia subaquàtica de Catalunya, Girona, Spain. 248 pp.

BOWLER, J.M., H. JOHNSTON, J.M. OLLEY, J.R. PRESCOTT, R.G. ROBERTS, W. SHAWCROSS, AND N.A. SPOONER. 2003. New ages for human occupation and climatic change at Lake Mungo, Australia. *Nature* 421:837–840.

BRIOIS, F., B. GRATUZE, AND J. GUILAINE. 1997. Obsidiennes du site néolithique précéramique de Shillourokambos (Chypre). *Paléorient* 23/1:95–112.

BROODBANK, C., AND T.F. STRASSER. 1991. Migrant farmers and the Neolithic colonization of Crete. *Antiquity* 65:233–45.

BUCHNER, G. 1994. Pithecusae nell'VIII sec. a.C.: crocevia del mondo antico. Pages 13–25 *in* G. Buchner and C., Gialanella, eds., *Museo Archeologico di Pithecusae, Isola d'Ischia*. Ministero per i Beni Culturali e Ambientali/Istituto Poligrafico e Zecca dello Stato, Roma, Italia.

BURGIO, E. 1997. Le attuali conoscenze sui mammiferi terrestri quaternary della Sicilia. Pages 62–71 *in* S. Tusa, ed., *Prima Sicvilia. Alle origini della società siciliana*. Regione Siciliana/Ediprint, Palermo, Italia.

CAMERON, M.A.S. 1968. Unpublished Paintings from the "House of the Frescoes" at Knossos. *The Annual of the British School of Archaeology at Athens* 63:1–31.

CAMPS, G. 1988. *Préhistoire d'un île*. Editions Errance, Paris, France. 284 pp.

CHERRY, J.F. 1979. our problems in Cycladic prehistory. Pages 22–47 *in* J.L. Davis and J.F. Cherry, eds., *Papers in Cycladic Prehistory*. University of California, Los Angeles, Institute of Archaeology, Monograph 14.

CHERRY, J.F. 1981. Pattern and process in the earliest colonization of the Mediterranean islands. *Proceedings of the Prehistoric Society* 47:41–68.

CHERRY, J.F. 1990. The first colonization of the Mediterranean islands: A review of recent research. *Journal of Mediterranean Archaeology* 3:145–221.

CHERRY J.F. 1992. Palaeolithic Sardinians? Some Questions of Evidence and Method. Pages 28–39 *in* R.H. Tykot and T.E. Andrews, eds., *Sardinia in the Mediterranean: A Footprint in the Sea*. Sheffield Academic Press, Sheffield, UK.

CODINO F. 1974. Introduzione. Pages vii–xxxiii *in* G. Tonna, ed., *Odissea*. Grazanti editore, Milano, Italia.

COSTA, L.J., J.-D. VIGNE, H. BOCHERENS, N. DESSE-BERSET, C. HEINZ, F. DE LANFRANCHI, J. MAGDELEINE, M.-P. RUAS, S. THIÉBAULT, AND C. TOZZI. 2003. Early settlement on Tyrrhenian islands (8th millennium cal.

BC): Mesolithic adaptation to local resources in Corsica and Northern Sardinia. Pages 3–10 *in* L. Larsson, H. Kindgre, K. Knutsson, D. Loeffler, and A. Åkerlund, eds., *Mesolithic on the Mour* Proceedings of the International Conference UISPP, Meso2000; Stockholm, Sept. 2000. Oxbow Books, Oxford, UK.

Cucchi, T., and J.-D. Vigne. 2006. Origin and diffusion of the house mouse in the Mediterranean. *Human Evolution* 21(2):95–106.

De Juliis, E.M. 1998. I navigatori micenei. Pages 29–36 *in* R. Cassano, ed., *Andra per mare. Puglia e Mediterraneo tra mito e storia*. Consorzio IDRIA7Mario Adda Editore, Bari, Italia.

Dermitzakis, M.D., and P.Y. Sondaar. 1978. The importance of fossil mammals in reconstructing paleogeography with special reference to the Pleistocene Aegean archipelago. *Annales Géologiques des Pays Helléniques* 29:808–840.

Doumas, C. 1992. *The Wall-paintings of Thera*. The Thera Foundation Petros M. Nomikos, Athens, Greece. 191 pp.

Fedele, F. 1988. Malta: origini e sviluppo del popolamento preistorico. Pages 51–90 *in* A. Fradkin Anati and E. Anati, eds., *Missione a Malta*. Jaca Book, Milano, Italia.

Fugazzola Delpino, M.A. and M. Mineo. 1995. La piroga neolitica del lago di Bracciano ("La Marmotta 1"). *Bullettino di Paletnologia Italiana* 86:197–266.

Guilaine, J. 1994. La Mer Partagée. *La Méditerranée Avant l'Écriture* (*7000–2000 avant Jesus-Christ*). Hachette, Paris, France. 456 pp.

Guilaine, J., and A. Le Brun, eds. 2003. Le Néolithique de Chypre (Actes Coll. Int. Nicosie, 17–19 mai 2001). Vol. suppl. 43. *Bulletin de Correspondances Helleniques*. 232 pp.

Guilane, J., F. Briois, J. Coularou, J.-D. Vigne, and I. Carrére 1996. Shillourokambos et les debuts du Neolithique à Chypre. *Espacia, Tiempo y Forma, Serie I, Prehistoria y Arquelogia* 9:159–171.

Guilaine, J., F. Briois, J.-D. Vigne, and I. Carrére. 2000. Découverte d'un Néolithique précéramique ancien chypriote (fin 9°, début 8° millénaires cal. BC), apparenté au PPNB ancien/moyen du Levant nord. *Comptes Rendus de l'Academie Sciences de Paris, Sciences de la Terre et des Planèts* 330:75–82.

Hadjisterkotis, E., and B. Masala. 1995. Vertebrate extinction in Mediterranean islets: an example from Cyprus. *Biogeographia* 18(1996):691–699.

Hammer, C.U., H.B. Clausen, W.L. Friedrich, and H. Tauber. 1987. The Minoan eruption of Santorini in Greece dated to 1645 BC? *Nature* 328:517–518.

Heubeck, A. 1981. Interpretazione dell'Odissea. Pages vii–xlii *in* G.A. Privitera, ed., *Omero, Odissea*. Arnoldo Mondatori Editore, Milano, Italia.

Immerwahr S.A. 1990. Swallows and Dolphins at Akrotiri: Some Thoughs on the Relationship of Vase-Painting to Wall-Painting. Pages 237–244 *in* D.A. Hardy, ed., *Thera and the Aegean world III*, Vol. I The Thera Foundation, London, UK.

Jacobsen, T.W. 1976. 17.000 anni di preistoria greca. *Le Scienze* 98:68–81.

Jacobsen, T.W. 1993. Maritime mobility in the Prehistoric Aegean. Paper presented at the XXth Meeting on Maritime Archaeology, Nafplion, Greece. 23 pp.

James, P. 1991. *Centuries of Darkness*. Jonathan Cape, London, UK. 434 pp.

Johnstone, P. 1988. *The Sea-craft of Prehistory*. Routledge, London, UK and New York, New York, USA. 184 pp.

Karageorghis, V., and N.C. Stampolidis, eds. 1998. Eastern Mediterranean. Cyprus-Dodecanese-Crete. 16th–6th cent. B.C. University of Crete and the A.G. Leventis Foundation, Athens, Greece. 313 pp.

Kirk, G.S. 1980. Introduction. Pages vii–xx *in* W. Sherwing, ed., *Homer. The Odyssey*. Oxford University Press, Oxford, UK/New York, New York, USA.

Lattimore, R. 1991. *The Odyssey of Homer*. HarperCollins Publishers, New York, New York, USA. 374 pp.

Lax, E., and T.F. Strasser. 1992. Early Holocene Extinctions on Crete: The Search for the Cause. *Journal of Mediterranean Archaeology* 5(2):203–224.

Lewthaite, J. 1987. Three steps to leaven: applicazione del modello di disponibilità al Neolitico italiano. *Atti della XXVI Riun. Scient. I.I.P.P. "Il Neolitico in Italia"*, Firenze, 7–10 November 1985:89–102.

MacArthur, R.H., and E.O. Wilson. 1967. *The Theory of Island Biogeography*. Princeton University Press, Princeton, New Jersey, USA. 203 pp.

Mannino, G. 2002. *Termini Imerese nella prehistoria*. Editrice GASM, Termini Imerese. 204 pp.

MARKETOU, T. 1998. Excavations at Trianda (Ialysos) on Rhodes: new evidence for the Late Bronze Age I period. *Rendiconti dell'Academia nazionale dei Lincei, Classe di scienze morali, storiche e filosofiche*, ser. 9, 9:39–82.

MARKETOU, T., 2006. Late Bronze Age IA/IB imitations of Cipriote ceramics. The evidence from Trianda (Ialysos). Pages 455–469 *in* E. Czerny, I. Hein, H. Hunger, D. Melman, and A. Schwab, eds., *Timelines. Studies in Honour of Manfred Bietak*, vol. II. *Orientalia Lovaniensia Analecta* 149.

MARINATOS, N. 1984. *Art and Religion in Thera. Reconstructing a Bronze Age Society*. D. and I. Mathioulakis, Athens, Greece. 128 pp.

MARINATOS, N. 1987. An Offering of Saffron to the Minoan Goddess of Nature: The Role of the Monkey and the Importance of Saffron. Pages 123–132 *in* T. Linders and G. Nordquist, eds., *Gifts to the God*. Proceedings of Uppsala Symposium 1985 (Boreas 15). *Acta Universitatis Uppsaliensis.*

MARINATOS, S. 1974. *Excavations at Thera VI (1872 season)*. Athens, Greece. 60 pp.

MASSETI, M. 1980. Le scimmie azzurre. La fauna etiopica degli affreschi minoici di Santorino (Thera). *Mondo archeologico* 51:32–37.

MASSETI, M. 1984. Antilopi o gazzelle sugli affreschi di Akrotiri? *Archeologia Viva* 7/8:26–27.

MASSETI, M. 1992. Fauna insulare. Alle origini del mito. *Ali Natura* 3:54–59.

MASSETI, M. 1993. On the Pleistocene occurrence of *Elephas* (*Paleoloxodon*) *antiquus* in the Tuscan archipelago, Northern Tyrrhenian Sea (Italy). *Hystrix*, (n.s.), 5(1–2):101–105.

MASSETI, M. 1997. Representation of birds in Minoan art. *International Journal of Osteoarchaeology* 7:354–363.

MASSETI, M. 1998. Holocene endemic and anthropogenous wild animals of the Mediterranean islands. *Anthropozoologica* 28:3–20.

MASSETI, M., 2000. Did the study of ethology begin in Crete 4000 years ago? *Ethology Ecology and Evolution* 1(12):89–96.

MASSETI, M., 2001. Did endemic dwarf elephants survive on Mediterranean islands up to protohistorical times? Pages 402–406 *in* G. Cavaretta, P. Gioia, M. Mussi, and M.R. Palombo, eds., *Proceedings of the 1st International Congress "The Land of the Elephants"*. Università degli Studi di Roma "La Sapienza", Roma, Italia.

MASSETI, M. 2002a. *Uomini e (non solo) topi. Gli animali domestici e la fauna antropocora*. Università degli Studi di Firenze: Firenze University Press, Firenza, Italia. 337 pp.

MASSETI, M., 2002b. The non-flying terrestrial mammals of the Mediterranean islands: an example of the role of the biological invasion of alienm species in the homogenisation of biodiversity. *Contributions to the "Workshop on Invasive Alien Species on European Islands and Evolutionary Isolated Ecosystems and Group of Experts on Invasive Alien Species". Horta, Azores (Portugal) (10-12 October 2002)*. Council of Europe, Strasbourg. T-PVS/IAS (2002) 2:4–6.

MASSETI, M., 2003a. Holocene endemic and non endemic mammals of the Aegean islands. *In* E. Kotjabopoulou, Y. Hamilakis, P. Halstead, C. Gamble, and P. Elefanti (a cura di): Zooarchaeology in Greece. Recent advances. *British School at Athens Studies* 9:47–57.

MASSETI, M., 2003b. Exploitation of fauna in the Near East during ancient historical times: observations on the mammalian species represented in Assyrian art. Pages 375–390 *in* C. Albore Livadie and F. Ortolani, eds., *Variazioni climatico-ambientali e impatto sull'uomo nell'area circum-mediterranea durante l'Olocene*. Centro Universitario Europeo per i Beni Culturali, Ravello. Edipuglia, Bari, Italia.

MASSETI, M., 2003c. Taxonomic and behavioural aspects of the representation of mammals in Aegean Bronze Age art.) *In* E. Kotjabopoulou, Y. Hamilakis, P. Halstead, C. Gamble, and P. Elefanti (a cura di): Zooarchaeology in Greece. Recent advances. *British School at Athens Studies* 9:267–275.

MASSETI, M., AND A. DARLAS. 1999. Pre-Neolithic man and other mammals on the Eastern Mediterranean islands. *Arkeos* 5:189–204.

MASSETI, M., AND P. MAZZA. 1996. Is there any paleontological "treatment" for the "insular syndrome"? *Vie Milieu* 46(3/4):355–363.

MASSETI, M., AND F. VIANELLO. 1991. Importazioni preistoriche di mammiferi alloctoni nelle isole del Mar Tirreno centro-settentrionale. *Rivista di Scienze Preistoriche* XLIII(1–2):275–292.

MORDANT, C., AND D. MORDANT. 1992. Noyen-sur-Seine: a Mesolithic waterside settlement. Pages 55–64 *in*

B. Coles, ed., *The Wetland Revolution in Prehistory*. Prehistoric Society Warp, Exeter, UK.

Niemeier, W.-D. 1998. The Minoans in the South-Eastern Aegean and Cyprus. Pages 29–45 *in* V. Karageorghis and N. Stampolidis, eds., *Eastern Mediterranean: Cyprus-Dodecanese-Crte 16th-6th cent. B.C.* University of Crete/A.G.Leventis Foundation, Athens, Greece.

Orliac, M. 1997. L'homme marin. Pages 39–53 *in* J.-D. Vigne, ed., *Îles. Vivre entre ciel et mer*. Éditions Nathan et Muséum national d'Histoire naturelle, Paris, France.

Papathanassopoulos, G. 1977. Early Helladic shipwreck at Dokos. *American Association of Archaeology* 9:17–23.

Patton, M. 1996. *Islands in Time*. Routledge, London, UK. 213 pp.

Payne, S. 1975. Faunal change at Franchthi Cave from 20,000 B.C. to 3,000 B.C. Pages 120–131 *in* A.T. Clason, ed., *Archaeozoological Studies*. North Holland Publishing, Amsterdam, Netherlands and New York, New York, USA.

Peltenburg, E., S. Colledge, P. Croft, A. Jackson, C. McCartney, and M.A. Murray. 2000. Agro-pastoralist colonization of Cyprus in the 10th millennium BP: initial assessments. *Antiquity* 74:844–853.

Pennacchioni, M. 1996. Correnti marine di superficie e navigazione durante il Neolitico. *Abstracts of the sections of the XIII International Congress of Prehistoric and Protohistoric Sciences*. Abaco, Forlì: 257–258.

Perlès, C. 1979. Des navigateurs méditerranéens il y a 10,000 ans. *La Recherche* 10:82–83.

Perlès, C. 2001. *The Early Neolithic in Greece. The First Farming Communities in Europe*. Cambridge University Press, New York, New York, USA. 356 pp.

Pulak, C. 1996. A Dendrochronological Dating of the *Uluburun* Ship. *INA Quarterly* 23:12–13.

Pulak, C. 1997. The *Uluburun* shipwreck. Pages 233–262 *in* S. Swiny, R.L. Holfelder, and H.W. Swiny, eds., *Res Maritimae: Cyprus and the Eastern Mediterranean from Prehistory to Late Antiquity* (Nicosia, Cyprus 18–21 October 1994). ASOR Archaeological Reports 4.

Rackham, O., and J. Moody. 1996. *The Making of the Cretan Landscape*. Manchester University Press, Manchester, UK and New York, New York, USA. 237 pp.

Ramis, D., J.A. Alcover, J. Coll, and M. Trias. 2002. The Chronology of the first settlement of the Balearic Islands. *Journal of Mediterranean Archaeology* 15:3–24.

Renfrew, C., and A.A. Aspinall. 1990. Aegean obsidian and Franchthi Cave, Pages 257–270 *in* C. Perlès, ed, *Les Industries Lithiques Tailées de Franchthi* (*Argolide, Grèce*), Tome 2. *Les industries lithiques du Mésolithique et du Néolithique initial*. Indiana University Press, Bloomington and Indianapolis, Indiana, USA.

Shackleton, J.C., T.H. Van Andel, and C.N. Runnels. 1984. Costal Palaeogeography of the Central and Western Mediterranean during the last 125,000 years and its Archaeological Implications. *Journal of Field Archaeology* 11:307–314.

Schüle W. 1993. Mammals, vegetation and the initial human settlement for the Mediterranean islands: a palaeontological approach. *Journal of Biogeograhy* 20:399–412.

Simmons, A.H. 1988. Extinct pygmy hippopotamus and early man in Cyprus. *Nature* 333:554–557.

Simmons, A.H. 1989. Preliminary report on the 1988 season at Akrotiri *Aetokremnos*, Cyprus. *Reports of the Department of Antiquities, Cyprus* 1989:1–5.

Simmons, A.H. 1991. Humans, island colonization and Pleistocene extinctions in the Mediterranean: the view from Akrotiri *Aetokremnos*, Cyprus. *Antiquity*, 249:857–869.

Simmons, A.H., ed. 1999. *Faunal Extinction in an Island Society. Pygmy Hippopotamus Hunters of Cyprus*. Klumer Academic/Plenum publishers, New York, New York, USA. 384 pp.

Stampolidis, N.C., A. Karetsou, and A. Kanta, eds. 1998. *Eastern Mediterranean. Cyprus-Dodecanese-Crete. 16th-6th cent. B.C.* University of Crete/Ministry of Culture, XXIII EPCA, Heraklion, Greece. 178 pp.

Stathopoulou, E.T., and G.E. Theodorou. 2001. Observations on the diagenesis of dwarf elephant skeletal remains from the island of Tilos (Dodekanese, Greece). Pages 557–562 *in* G. Cavaretta, P. Gioia, M. Mussi, and M.R. Palombo, eds., *Proceedings of the 1st International Congress "The Land of the Elephants"*. Università degli Studi di Roma "La Sapienza", Roma, Italia.

Stucchi, S. 1976. Il Giardino delle Esperidi e le tappe della conoscenza greca della costa cirenaica. *Quaderni di Archeologia lybica* 8:115–147.

Symeonidis, N.K 1972. Die Entdeckung von Zwergelefanten in der Höhle "Charkadio" auf der Insel Tilos

(Dodekanes, Griechenland). *Annales géologiques des pays hélleniques* 24:445–461.

SYMEONIDIS, N.K., F. BACHMAYER, AND H. ZAPFE. 1973. Grabungen in der Zwergelefanten-Höhle Charkadio auf der Insel Tilos (Dodekanes, Griechenland). *Annalen des Naturhistorisches Museum in Wien* 77:133–139.

SYMEONIDIS, N.K., AND G.E. THEODOROU. 1981. New findings of fossil elephants on Crete island. *Annales géologique des pays helléniques* 31:113–129.

TELEVANTOU, C.A. 1990. New Light on the West House Wall-Paintings. *TAW III* 1:309–326.

THEODOROU, G.E. 1983. *Die fossilen Zwergelefanetn der Höhle "Charkadio" auf der Insel Tilos, Dodekanes.* Dissertation. University of Athens, Athens, Greece. 231 pp.

THEODOROU, G.E. 1988. Environmental factors affecting the evolution of island endemics: the Tilos example from Greece. *Modern Geology* 13:183–188.

THEODOROU, G.E., AND K. AGIADI. 2001. Observations on the microstructure of fossil tusks from the Charkadio cave (Tilos, Dodekanese, Greece). Pages 563–567 *in* G. Cavaretta, P. Gioia, M. Mussi, and M.R. Palombo, eds., *Proceedings of the 1st International Congress "The Land of the Elephants"*. Università degli Studi di Roma "La Sapienza", Roma, Italia.

THEODOROU, G.E., AND N.K. SYMEONIDIS. 2001. The excavations of the last ten years at Charkadio cave on Tilos island, Dodekanese, Greece. Pages 514–518 *in* G. Cavaretta, P. Gioia, M. Mussi, and M.R. Palombo, eds., *Proceedings of the 1st International Congress "The Land of the Elephants"*. Università degli Studi di Roma "La Sapienza", Roma, Italia.

THEODOROU, G.E., AND N.K. SYMEONIDIS, AND E. STATHOPOULOU. 2007. *Elephas tiliensis* n. sp. from Tilos Island (Dodecanese, Greece). *Hellenic Journal of Geosciences* 42:19–32.

TOZZI, C. 1996. L'abri prénéolithique de Porto Leccio (Sardaigne septentrionale). Actes des 3e journées universitaires corses de Nice (19–20 mai 1995), Université de Nice 1996:11–16.

TRANTALIDOU, K. 2000. Animal bones and animal representations at late Bronze Age Akrotiri. Pages 709–734 *in* S. Sherratt, ed., *The Wall Paintings of Thera.* Thera Foundations-Petros M. Nomikos and The Thera Foundation, Athens, Greece.

TZALAS, H. 1995. On the obsidian trail. With a papyrus craft in the Cyclades. Pages 441–469 in *Trophis III. 3rd International Symposium on Ship Construction in Antiquity, Athens 1989.* Hellenic Institute for the Preservation of Nautical Traditions, Athens, Greece.

UERPMANN, H.-P. 1979. *Probleme des Neolithisierung des Mittelmeersraumen.* Beihefte Tübingen Atlas Vorderes Orient Reihe. B28. Reichert, Wiesbaden, Germany. 184 pp.

VAN ANDEL, T.H. 1989. Late Quaternary Sea-Level Changes and Archaeology. *Antiquity* 63:733–745.

VAN ANDEL, T.H. 1990. Addendum to "Late Quaternary Sea-Level Changes and Archaeology". *Antiquity* 64:151–152.

VANSCHOONWINKEL, J. 1990. Animal Representations in Theran and Other Aegean Arts. Pages 252–266 *in* D.A. Hardy, ed., *Thera and the Aegean World III.* The Thera Foundation, London, UK.

VANSCHOONWINKEL, J. 1996. Les Animaux dans l'art minoen. Pages 351–412 *in* D.S. Reese, ed., *Pleistocene and Holocene Fauna of Crete and Its First Settlers.* Prehistory Press, Madison, Wisconsin, USA.

VAUFREY, R. 1929. Les elephants nains des Iles Mediterraneennes et al question des isthmes pleistocenes. *Archives de l'Institut de Paleontologie Humaine, Memoire* 6:1–220.

VIGNE, J.-D. 1999. The large "true" Mediterranean as a model for the Holocene human impact on the European vertebrate fauna? Recent data and new reflections. Pages 295–322 *in* N. Benecke, ed., *The Holocene History of the European Vertebrate Fauna. Modern Aspects of Research* (Workshop, 6th–9th April 1998, Berlin). Deutsches Archaologisches Institut, Eurasian-Abteilung, Berlin, Germany.

VIGNE, J.-D. 2000. Les chasseurs préhistoriques dans les îles méditerranéennes. *Pour la Science* Dossier Hors-Série, "la valse des espèces":132–137.

VIGNE, J.D., AND H. BUITENHUIS. 1999. Les premiers pas de la domestication animale à l'Ouest de l'Euphrate: Chypre et l'Anatolie centrale. *Paléorient* 25:49–62.

VIGNE, J.-D., AND T. CUCCHI. 2005. Premières navigations au Proche-Orient: les informations indirectes de Chypre. *Paléorient* 31:195–204.

VIGNE, J.-D., AND N. DESSE-BERSET. 1995. The exploitation of animal resources in the Mediterranean Islands during the Pre-Neolithic: the example of Corsica. Pages 309–318 *in* A. Fischer, ed., *Man and Sea in the*

Mesolithic. Oxbow Books, Oxford, UK.

Vigne, J.-D., V. Bourdillat, J. André, J.E. Brochier, B.T. Mai, J. Cuisin, H. David, N. Desse-Berset, C. Heinz, F. de Lanfranchi, M.-P. Ruas, S. Thiébault, and C. Tozzi. 1996. Nouvelles données sur le Prénéolithique corse: premiers résultats de la fouille de l'abri du Monte Leone (Bonifacio, Corse-du-sud). Production et identité culturelle. Actualité de la recherche. *Rencontre méridionales de la préhistoire récente., Antibes* 1996:251–260.

Vigne, J.-D., I. Carrere, J.F. Saliege, A. Person, H. Bocherens, J. Guilaine, and F. Briois. 2000. Predomestic cattle, sheep, goat and pig dring the late 9th and the 8th millenium cal. BC on Cyprus: preliminary results of Shillourokombos (Parekklisha, Limassol). Pages 52–75 *in* M. Mashkour, A.M. Choyke, and H. Buitenhuis, eds., *Archaeozoology of the Near East IV roc. 4th International Symposium on the Archaeozology of Southwestern Asia and Adjacent Areas* (*ASWA. Paris juin 1998*). Archaeological Research and Consultancy (Publicaties 32), Groningen, Netherlands.

Vinton Kirch, P. 1997. *The Lapita peoples. Ancestors of the Oceanic World. The Peoples of South-East Asia and The Pacific*. Blackwell, Oxford, UK. 348 pp.

Vivian Davies, W., and L. Schofield, eds. 1995. *Egypt, the Aegean and the Levant. Interconnections in the Second Millennium BC*. The Trustees of the British Museum, London, UK. 156 pp., 32 pls.

Warren, P. 1995. Minoan Crete and pharaonic Egypt. Pages 1–18 *in* W. Vivian Davies and L. Schofield, eds., *Egypt, the Aegean and the Levant, Interconnections in the Second Millennium BC*. The Trustees of the British Museum, London, UK.

Willcox, . 2001. Présence des céréales dans le Néolithique précéramique de Shillourokombos à Chypre: résultats de campagne 1999. *Paléorient* 26.1:129–135.

Yannouli, E., and K. Trantalidou. 1999. The fallow deer (*Dama dama* Linnaeus, 1758): Archaeological presence and representation in Greece. Pages 247–281 *in* N. Benecke, ed., *The Holocene History of the European Vertebrate Fauna. Modern Aspects of Research*. Verlag Marie Leidorf GmbH, Rahden/Westf., Germany.

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The Natural History Museum of Florence and Its Contribution to the Knowledge of the Mediterranean

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The Florence Natural History Museum was promoted in the 18th century by the enlightened Grand Duke Peter Leopold. Its opening to the public in 1775 represented an unprecedented event as, until then, natural history museums were viewed as places exclusively reserved for nobles and scholars.

During its long history, many of the Museum staff have contributed to the exploration and scientific documentation of the Mediterranean. The Museum's sections, which house a large quantity of scientific material, collected from throughout the Mediterranean region, bear witness to the role played by the institution in exploring and expanding our knowledge of this interesting geographical area.

The origin of the collections from the Mediterranean can be ascribed to two different sources. The first, constituted by material collected during several scientific institutional expeditions, focused on the study of peculiar sites largely to document their natural history; the second, the specimens, objects, and other items accumulated, donated or exchanged by private researchers. Although the latter were not collected by Museum staff as a result of their own explorations of the Mediterranean area, they are, nonetheless, significant inasmuch as they are the voucher materials upon which numerous chorologic and biogeographic studies have been based.

The present work considers the contributions of each of the sections of the Natural History Museum of Florence University to the scientific exploration and understanding of the Mediterranean basin, with short accounts of the main personalities involved.

Il Museo di Storia Naturale di Firenze nacque sulla scorta delle idee illuministe del XVIII seolo e fu voluto dal Granduca Pietro Leopoldo. La sua apertura al pubblico, nel 1775, costituì un evento senza precedenti nel panorama dei musei di storia naturale, fino ad allora considerati appannaggio solo di nobili e studiosi. Durante la sua lunga storia, molti dei personaggi che hanno operato presso il Museo hanno contribuito all'esplorazione e all'illustrazione scientifica del Mediterraneo. Presso le sezioni del Museo si conservano abbondanti materiali scientifici, raccolti in varie parti del bacino del Mediterraneo che testimoniano il ruolo avuto dall'istituzione nella conoscenza di questa interessante area geografica.

Se guardiamo all'origine delle raccolte e dei reperti provenienti dall'area mediterranea vedi-

[1] Components of the "Group on Historical Research" of the Natural History Museum, Florence, Italy.

amo che essi possono essere ricondotti a due tipologie di acquisizione. La prima, costituita da materiale raccolto durante spedizioni istituzionali finalizzate allo studio di aree ben precise con fondazione di raccolte speciali che documentano la storia naturale di determinati luoghi; la seconda, formata da reperti radunati tramite raccolte, acquisti e scambi da singoli studiosi esterni al Museo che hanno costituito nel tempo collezioni private che, solo secondariamente sono entrate a far parte del Museo di Storia Naturale. Sebbene il materiale di questa tipologia non racconti il contributo diretto del Museo all'esplorazione del Mediterraneo, riveste comunque un'importanza di primo piano per la conoscenza scientifica dell'area, perché è su tali raccolte che sono stati compiuti studi corologici e biogeografici, pubblicati in lavori di varia entità.

Vediamo adesso il contributo delle singole sezioni del Museo di Storia Naturale dell'Università di Firenze all'esplorazione scientifica del Bacino del Mediterraneo.

Orto Botanico

Il 1 Dicembre 1545 Cosimo I dei Medici fondò a Firenze il Giardino dei Semplici. Il disegno originale fu curato da Niccolò di Raffaello di Niccolò dei Pericoli, detto il Tribolo, mentre a Luca Ghini (1490–1556) spettò il compito sovrintendere alla sua costruzione e di introdurvi piante medicinali ad uso sia degli studenti che della sua attività didattica (Cellai Ciuffi e Fabbri 1992; Luzzi e Fabbri 1993). Il Ghini, a tale scopo, intraprese numerosi viaggi e spedizioni per raccogliere le piante da introdurre nel nascente Orto, percorrendo sia l'entroterra che il litorale toscano (Ragazzini 1993). Con il Ghini nacquero così le prime raccolte sistematiche volte all'osservazione diretta da parte degli studenti delle specie botaniche presenti in natura o messe in coltivazione nelle Scuole Botaniche e negli Orti botanici.

Nello stesso periodo, il fiammingo Jodocus De Goethuysen (1535–1595) — italianizzato in Giuseppe Casabona o Benincasa — fu direttore dell'Orto Botanico di Firenze dal 1586 al 1592 circa e con Niccolò Gaddi, patrizio fiorentino, intraprese numerosi viaggi alla ricerca di piante anche in Toscana, Corsica e soprattutto a Creta tra il 1590 e il 1591. Successivamente, dal 1592 al 1595, Casabona divenne "prefetto" dell'Orto botanico pisano (Fabbri 1963; Battistini 1927).

Nel 1718, per volontà di Cosimo III dei Medici, il giardino botanico fu affidato alle cure della Società Botanica Fiorentina ed ebbe come Direttore il grande studioso fiorentino Pier Antonio Micheli (1679–1737), fondatore della Società stessa. Negli anni trascorsi sotto la guida del Micheli, l'Orto assurse a grande fama. Micheli intraprese numerose escursioni botaniche in tutta Italia ed iniziò a coltivare nel giardino piante indigene della Toscana ed anche specie esotiche. Esistono numerosi manoscritti del Micheli sulle piante raccolte durante i suoi viaggi nelle province toscane di Pisa e di Livorno, in Abruzzo e in Puglia per "*essere introdotte nel Giardino dei Semplici di Firenze*". Particolare interesse rivestono inoltre i manoscritti del 1704 sulla flora dell'isola di Gorgona (Ragazzini 1993). Negli anni della sua direzione Micheli iniziò a scrivere il *Catalogus Plantarum Horti Cesarei Florentini* che restò incompiuto ed inedito.

Giovanni Targioni Tozzetti (1712–1783), discepolo del Micheli, che gli succedette alla direzione dell'Orto botanico nel 1737, proseguì nell'opera del maestro prediligendo la cura delle piante di interesse botanico che lui stesso procurò di introdurre nell'orto durante le sue escursioni scientifiche, tra le quali si ricorda quelle svolte nel 1742 lungo la costa tirrenica per raccolte naturalistiche, non solo botaniche (Targioni Tozzetti 1768–1779). Al Targioni si deve inoltre l'aver rivisto e completato il famoso catalogo del Micheli che fu pubblicato nel 1748 (Micheli 1748).

Anche suo figlio Ottaviano (1755–1829), che diresse l'Orto dal 1801 al 1829, ebbe molto interesse verso il giardino introducendo numerose piante e alberi di interesse botanico e piante medicinali dell'area mediterranea (Targioni Tozzetti 1841; Cipriani et al. 2000).

Teodoro Caruel (1830–1898) fu direttore dell'Orto Botanico dal 1866 al 1896. Con lui iniziò il trasferimento delle piante dall'Orto botanico della Specola al Giardino dei Semplici (Caruel 1881) e molte piante furono introdotte sotto la sua direzione. Scrisse il *Prodromo della flora toscana* (1860–1864), pubblicazione che ebbe da subito grande risonanza, in quanto riuniva e organizzava le conoscenze fino ad allora acquisite sulla flora della regione toscana. Successivamente Caruel pubblicò i Supplementi (1866 e 1870), promuovendo l'esplorazione sistematica delle zone poco conosciute della regione.

Nel secolo passato i botanici esploravano l'area mediterranea ai fini dello studio della flora e della raccolta di materiale da inviare nel Giardino botanico e all'Erbario Centrale; già negli anni '60 si delineava un diverso approccio di ricerca nell'Isola di Montecristo (Fabbri 1964; Fabbri 1971) e, più recentemente l'Orto si è dedicato a studi nell'Arcipelago seguendo le linee guida delle organizzazioni internazionali in materia di conservazione della biodiversità (AA.VV. 2001; WWF e IUCN BCGI 1989), eseguendo monitoraggi, ricerche e progetti soprattutto a fini conservazionistici sul territorio regionale, con particolare riferimento all'Arcipelago Toscano. Fra tali attività ricordiamo la partecipazione ai progetti RETE 2000, BIOITALY e 5-BIOS per l'attuazione delle fasi ricognitive della Direttiva 92/43 CEE con l'individuazione, delimitazione e caratterizzazione dei pSIC e lo studio della distribuzione di piante rare anche dell'Arcipelago e della Maremma; la collaborazione con la Regione Toscana per l'aggiornamento dei dati relativamente al progetto RE.NA.TO. (Repertorio Naturalistico Toscano), che raccoglie indicazioni sulle emergenze floristiche, faunistiche e vegetazionali (Sposimo e Castelli 2005); gli studi sulla valutazione della biodiversità in aree protette (Parco della Maremma); monitoraggi del ripristino di habitat seminaturali (Arcipelago Toscano); ricerche floristiche e vegetazionali in varie zone della Toscana, compreso l'Arcipelago (Foggi e Grigioni 1999; Foggi et al. 1999, 2000).

In conclusione si può notare, facendo anche riferimento alla lettura di antichi cataloghi e manoscritti, che da oltre 450 anni, non è mai venuta meno l'attenzione degli studiosi che hanno diretto il giardino, nel promuovere l'incremento e la coltivazione di piante dell'areale mediterraneo.

Attualmente infatti l'Orto Botanico sta proseguendo su questa linea e ad oggi sono in coltivazione 202 piante raccolte nell'areale mediterraneo. Tali piante appartengono a diverse collezioni tematiche: 57 alle medicinali, 29 alle commestibili selvatiche della Toscana, 22 alle monocotiledoni, 18 agli arbusti, 16 alle velenose e poi agli alberi, alle palme, alle endemiche e rare toscane, alle acquatiche, alle pteridofite, alle alimentari. Questo settore subirà in futuro ulteriori incrementi non solo per seguire le moderne concezioni sulle finalità di un orto botanico attuale, ma anche per non dimenticare la via tracciata dai nostri illustri predecessori.

BOTANICA

Nella Sezione Botanica si conserva il più importante erbario d'Italia, con oltre 4 milioni di campioni. La provenienza di gran parte delle raccolte è la regione mediterranea sia per ragioni dovute alla posizione geografica del nostro paese, sia per motivi storici e, pertanto, sin dalla sua istituzione ad opera di Filippo Parlatore nel 1842 (Visconti 2004), è uno dei centri maggiori di aggregazione per i botanici dell'area mediterranea (Cuccuini 2003a, 2003b; Nepi 2005; Cuccuini e Nepi 1999).

Se si esclude l'estrema parte nord occidentale, fino ai primi decenni del '900, le raccolte nel bacino del Mediterraneo furono effettuate soprattutto da parte di singoli personaggi. Successivamente, in particolar modo nel secondo dopoguerra, esse furono compiute istituzionalmente e mirate nella scelta dell'area, spesso senza nemmeno riportare sulle etichette l'indicazione dei raccoglitori.

Ciò fu dovuto, da un lato, al tramonto dell'era dei "raccoglitori pionieri" e dall'altro all'affermarsi di un impegno mirato e generalizzato nei fini e nella volontà di integrare i dati delle ricerche.

Qui di seguito saranno descritti brevemente, a partire dalla nascita della Sezione Botanica, gli apporti di materiali mediterranei, evidenziando i principali personaggi e le maggiori istituzioni artefici delle raccolte.

Tra le collezioni formatesi in tutto o in parte prima del 1842, anno della fondazione dell'Herbarium Centrale Italicum, vi sono i materiali delle collezioni di Giuseppe Raddi (1770–1829), di Philip Barker Webb (1793–1854) e del giovane Filippo Parlatore (1816–1877).

Procedendo in ordine cronologico incontriamo per prime le collezioni di Giuseppe Raddi in Egitto, effettuate fra l'altro, in misura consistente in aree del Delta e nelle oasi dell'Egitto nord-occidentale nel 1828 (Fig. 1). Le raccolte furono compiute nell'ambito di una missione franco-toscana nata dalla collaborazione fra Jean-Francois Champollion, già famoso per la decifrazione della stele di Rosetta e quindi dei geroglifici egiziani, e Ippolito Rosellini, professore di lingue orientali all'Università di Pisa. La spedizione fu progettata dal Granduca Leopoldo II e doveva approfondire gli aspetti storico-archeologici dell'Egitto, ma il giovane Granduca, molto amante delle scienze, volle indicare tra i partecipanti anche il Raddi affinché la missione fosse utile anche sotto il profilo naturalistico.

FIGURE 1. Herbarium specimen of *Ochradenus baccatus*, collected by G. Raddi in Egypt.

FIGURA 1. Exsiccata di *Ochradenus baccatus*, raccolto da G. Raddi in Egitto.

Ci sono poi le collezioni giovanili di Filippo Parlatore, effettuate in Sicilia (oltre 30.000 esemplari) e costituenti il nucleo fondamentale del suo Herbarium Parlatoreanum (Parlatore 1874).

Nel 1854 giunse infine l'Erbario Webb, contenente, tra l'altro, le sue raccolte giovanili effettuate proprio nella regione mediterranea. Egli, infatti, a partire dal 1819 e per più di un anno, viaggiò per la Grecia e la Turchia insieme al giovane naturalista Alberto Parolini di Bassano del Grap-

pa, visitando i resti delle antiche civiltà, facendo osservazioni di carattere geologico e raccogliendo piante che, insieme a quelle prese in Italia, costituiranno le sue prime raccolte botaniche (Parlatore 1856). In seguito, tra il 1826 ed il 1828, viaggiò per la Spagna ed il Portogallo, visitandone molte località e raccogliendo numerose specie nuove per la Scienza.

Sul versante africano del bacino mediterraneo spiccano, su un totale di alcune decine di migliaia di esemplari, quelli di provenienza algerina, frutto soprattutto delle raccolte ottocentesche di Alfred Chabert (1836–1916), effettuate nell'arco di circa un decennio (1860–1872) in gran parte nelle aree costiere di quella, allora, colonia francese, nella quale espletò il servizio di medico militare (Fig. 2).

FIGURE 2. Herbarium specimen of *Helianthemum niloticum*, collected by A. Chabert.

FIGURA 2. Exsiccata di *Helianthemum niloticum*, raccolto da A. Chabert.

Per il Marocco le collezioni sono poco ricche ed estremamente frammentarie, mentre sul versante europeo, sono in evidenza le raccolte spagnole, sia della Spagna continentale che delle sue isole mediterranee, per oltre 6.000 campioni. Questo dato non considera tutto il materiale mediterraneo acceduto a Firenze con l'Erbario Webb e con le importantissime collezioni di Rupert Huter (1834–1919), Pietro Porta (1832–1923) e Gregorio Rigo (1841–1922), che da soli o in collaborazione (Porta e Rigo, raccolte dal 1885 al 1895), (Porta, Rigo e Huter, raccolte del 1879) erborizzarono in molte località spagnole e, fra queste, nelle aree costiere di fronte alle Baleari ed in queste stesse isole.

Nel XX secolo e fino ai nostri giorni si sono succeduti quasi esclusivamente scambi istituzionali con vari erbari, in grande prevalenza spagnoli. Minore è la presenza di collezioni della flora francese mediterranea, se si escludono le regioni confinanti con l'Italia (ad esempio, la Var).

In questa breve trattazione non si citano le raccolte propriamente italiane e quindi del Mediterraneo centrale, che costituiscono ovviamente il cuore delle collezioni della Sezione Botanica.

Più interessanti, iniziando dalla sponda africana, e fondamentali ancora oggi per lo studio della flora di quel paese, le raccolte effettuate in Libia da Renato Pampanini (1875–1949), il primo vero

conservatore *ante litteram* di collezioni botaniche, effettuate in tre momenti diversi, 1913, 1933 e 1934 (in particolare in Tripolitania, nell'ambito della spedizione Franchetti, e in Cirenaica) per oltre 10.000 reperti.

Meno numerosi i campioni provenienti dalla Tunisia (circa 1.650 campioni, con raccolte dal 1857 ad oggi) anche se comprendono le antiche raccolte del franco-alsaziano Jean Louis Kralik (1813–1892); che erborizzò nella parte nord occidentale del paese dal 1845 al 1850, inviando 344 *exsiccata* a Firenze nel 1857 e, quelle dei nostri giorni effettuate del Prof. Mauro Raffaelli, attualmente in servizio presso il Dipartimento di Biologia Vegetale dell'Università di Firenze, che dal 1986 al 1989, insieme al tecnico Carlo Ricceri, raccolse oltre 700 campioni tunisini.

Dei territori italiani sono da ricordare in particolare le raccolte sarde: oltre 43.000 campioni registrati, fra i quali quelli del Prof. Pier Virgilio Arrigoni del Dipartimento di Biologia Vegetale di Firenze ne costituiscono la quasi totalità, anche se non mancano le collezioni dei precursori di questa flora, come quelle di Giuseppe Giacinto Moris (1796–1869). Le raccolte di Arrigoni, compiute in tutto il territorio sardo, piccole isole comprese, hanno occupato buona parte del secondo dopoguerra (dal 1957 a livello personale, dal 1967 per l'Università di Firenze) e si protraggono sino ad oggi, costituendo la base del progetto della Flora Sarda, della quale finalmente si è vista l'uscita del primo volume (Arrigoni 2006), oltre a centinaia di lavori settoriali sia di flora che di vegetazione dell'isola. La quantità di campioni ricordata riguarda solo il materiale già registrato: se si considera anche quello ancora da registrare, oltre ai duplicati, il contingente raddoppia abbondantemente.

La Fondazione Parlatore, nata proprio allo scopo di studiare la flora e la vegetazione italiane, solo dagli anni Sessanta del secolo scorso, ha finanziato la raccolta di quasi 9.000 campioni in tutte le aree mediterranee italiane (in gran parte isole) esclusa la Sardegna e, di questi, oltre 3.500 raccolti in Sicilia, dal 1969 al 1980, a seguito di progetti mirati dell'Università di Firenze. Questi vanno ad aggiungersi alle precedenti donazioni, come quelle di Giovanni Gussone (1787–1866), Vincenzo Tineo (1791–1856), Michele Lojacono Poiero (1853–1919) e Agostino Todaro (1818–1892) per oltre 3.000 campioni raccolti in tutta l'isola.

Per gli arcipelaghi minori, possiamo citare le raccolte di Stefano Sommier (1848–1922), botanico francese d'origine, ma italiano d'adozione (Fig. 3). Si tratta di oltre 7.000 campioni, raccolti nell'arco di tutta la sua vita, che hanno interessato in particolare l'Arcipelago Toscano e le Isole Pelagie, oltre a discrete raccolte nell'Arcipelago Maltese.

Anche a queste fanno da riscontro in epoca contemporanea le interessanti raccolte, sempre nell'Arcipelago Toscano, della Prof.ssa Teresa

FIGURE 3. Portrait of Stefano Sommier (photo by Brogi, Florence).

FIGURA 3. Ritratto di Stefano Sommier (foto Brogi, Firenze).

Fossi Innamorati (circa 1.000 campioni dell'Elba, negli anni 1970–1981) e del Dr. Riccardo Maria Baldini (1.700 campioni delle isole minori del medesimo arcipelago e dell'Argentario, negli anni 1978–1991), a cui hanno fatto seguito le pubblicazioni delle flore di tutte le isole dell'arcipelago (meno Montecristo e Capraia già studiate da altri) (Baldini 1990, 1991, 1995, 1998, 2000; Fossi Innamorati 1983, 1989, 1991, 1994; Nepi 1997).

Importanti anche le collezioni della Corsica, giunte a Firenze dal 1847 ad oggi, per un totale di quasi 5.000 campioni, la metà dei quali si riferisce a collezioni del XIX secolo. Anche in quest'area alcuni personaggi hanno avuto un ruolo di primaria importanza; tra questi si possono citare Esprit Requien (1788–1851), Alexis Thomas Claude Jordan (1814–1897) e l'insegnante del liceo di Bastia, Jules Paul Mabille (1835–1823) che inviarono a Firenze dal 1847 al 1868 quasi 2.300 campioni. In tempi moderni sono invece da ricordare le raccolte del Prof. Benedetto Lanza, che dal 1971 al 1975 erborizzò in particolare nelle isole minori della Corsica e grazie al quale arrivarono altri 1.220 *exsiccata* dall'area corsa.

La parte orientale del Mediterraneo orientale è forse l'area più interessante dal punto di vista delle indagini botaniche che vi si sono svolte e dei personaggi che le hanno effettuate. Iniziando dalla costa africana e in particolare dall'Egitto, la Sezione annovera circa 4.000 campioni, raccolti dal 1844 al 1977. In questo periodo, è infatti attivo nell'area Antonio Figari (1804–1870) (Fig. 4), farmacista genovese e influente funzionario ottomano del vicereame d'Egitto (da cui il titolo di Bei), che alla sua morte legò al Museo il suo erbario personale, costituito da "*diverse decine di migliaia di esemplari*" raccolti nell'arco della sua vita (Fig. 5). Personaggio leggendario e appassionato in ogni ramo delle scienze naturali, Figari fu in relazione con molti dei naturalisti dell'epoca, che omaggiò di reperti di ogni tipo e provenienti da un'area vastissima. Egli infatti, per il suo incarico politico, fece moltissime escursioni in cui la passione naturalistica non fu da meno rispetto all'impegno professionale. Visitò l'Egitto e tutto il vicino Oriente fino alla parte europea dell'impero turco, ma non mancò di spingersi anche nell'estremo sud dell'antico stato ottomano fino all'odierno Sudan e in parte dell'attuale Etiopia, oltre che in Arabia. Notevole la collezione che radunò, metà della quale è stata raccolta in ambienti mediterranei, che contribuì grandemente allo sviluppo delle prime conoscenze floristiche di tutti questi territori. Per la Turchia sono presenti in Erbario circa 3.000 campioni, in massima parte raccolti dallo stesso Figari, ai quali si aggiungono poche centinaia di campioni recenti, frutto di scambi internazionali o con alcune Istituzioni.

FIGURE 4. Portrait of Antonio Figari, October 1866 (photo from Parlatore archive).

FIGURA 4. Ritratto di Antonio Figari, Ottobre 1866 (foto dall'archivio Parlatore).

Sulla sponda europea troviamo le raccolte della Grecia, che ammontano a quasi 10.000

campioni raccolti dal 1845 ad oggi, oltre due terzi dei quali furono raccolti prima del 1900. Fra le raccolte dei pionieri della ricerca botanica in quest'area spiccano quelle del tedesco Theodor von Heldreich (1822–1902), radunate in un periodo lunghissimo (1843–1849; 1851–1902). Vista l'importanza scientifica delle sue collezioni, i suoi campioni (come serie di *exsiccata*) furono diffusi nei più importanti erbari europei dell'epoca. Nell'Erbario Centrale è presente anche materiale di un altro importante esploratore botanico della flora greca, Theodoros Georgios Orphanides (1817–1886): si tratta di oltre 800 esemplari raccolti alla fine degli anni '60 del XIX secolo e giunti a Firenze nel 1871 (Fig. 6). Per l'isola ionica di Corfù, vanno poi ricordate le raccolte di Mazzoni, ricche di ben 2.500 campioni.

In epoca moderna l'interesse per la Grecia è continuato con molte raccolte del personale dell'attuale Dipartimento di Biologia Vegetale di Firenze, e con gli apporti dovuti a Istituzioni botaniche greche.

Per i paesi balcanici, ricordiamo le collezioni di Antonio Baldacci (1867–1950), un ufficiale dell'esercito italiano, che erborizzò in più riprese nei Balcani sud-occidentali e a Creta dagli anni '80 del 1800 fino alla fine del secolo, con particolare attenzione per l'Albania e le sue coste (1.500 campioni). Anche Pampanini donò importanti collezioni fatte nel Dodecaneso (incluso Rodi e l'Egeo orientale) per circa un migliaio di campioni, che si aggiunsero ad altrettanti reperti, già presenti in Erbario, raccolti da moltissimi botanici e viaggiatori nell'arco di oltre un secolo e mezzo (1761–1924) e frutto di donazioni.

FIGURE 5. Herbarium specimen of *Abutilon figari* = *Abutilon muticum* Webb = *Sida mutica* Del. *(Herbarium Webbianum).*

FIGURA 5. Exsiccata di *Abutilon figari* = *Abutilon muticum* Webb = *Sida mutica* Del. *(Herbarium Webbianum).*

Le collezioni contemporanee, relative sia all'Italia sia ad altri paesi del Mediterraneo, oltre alle già citate raccolte in Sardegna e Sicilia, effettuate nell'ambito della Fondazione Parlatore fino al 1981 (anno in cui si è sciolta la Fondazione stessa), hanno interessato tante altre località mediter-

ranee dell'Italia centro-meridionale per un totale di 5.000 campioni. Contemporaneamente o successivamente a queste si sono avute altre spedizioni, che hanno fruttato altre decine di migliaia di *exsiccata,* condotte nell'ambito di progetti finalizzati all'indagine dei "gruppi floristici critici" del C.N.R., poi anche direttamente finanziate dai Ministeri, in quasi tutte le regioni italiane. Fra queste spiccano, per durata e complessità, quelle effettuate dal Prof. Guido Moggi nel Cilento (Campania) dal 1951 al 2000 e che hanno dato luogo, nel 2002, al *Catalogo della Flora del Cilento.*

In anni recenti un'importante funzione, segno dei tempi e di un diverso modo di fare raccolte, è stata rivestita dalla *Société pour l'échange des plantes vasculaires de l'Europe et du bassin du Méditerranéen*, una società di scambio internazionale, e dalle escursioni dell'O.P.T.I.M.A. (*Organization for the Phyto-Taxonomic Investigation of the Mediterranean Area*), attualmente la più importante organizzazione internazionale degli studiosi della Flora Mediterranea. Esse hanno organizzato erborizzazioni quasi annuali in tutti i paesi del bacino del Mediterraneo (e non solo) o rivolgendosi a raccoglitori collegati ai vari membri aderenti all'organizzazione (la *Société*) o organizzando proprie escursioni con raccoglitori appartenenti alle Istituzioni associate (l'O.P.T.I.M.A.). Dal 1976 al 2000 sono così pervenuti dalla *Société* quasi 11.000 campioni, mentre dagli itinerari dell'O.P.T.I.M.A. quasi 2.300 *exsiccata*, frutto della partecipazione al Primo e al Quarto *iter*, svoltisi rispettivamente in Spagna nel 1988 e a Cipro nel 1991. Si tratta di materiale preparato e revisionato da specialisti dei vari settori, con un notevole aggiornamento, sia cronologico che tassonomico, delle raccolte mediterranee presenti a Firenze.

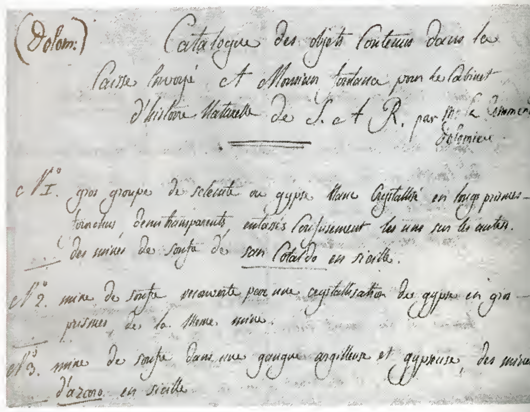
FIGURE 6. Herbarium specimen of *Clematis cirrhosa*, collected by T.G. Orphanides.

FIGURA 6. Exsiccata di *Clematis cirrhosa*, raccolta da T.G. Orphanides.

Nel loro complesso le collezioni botaniche a distribuzione mediterranea del Museo di Storia Naturale interessano circa 2 milioni di campioni, raccolti da varie centinaia di raccoglitori.

Mineralogia

Sebbene non vi siano state spedizioni o escursioni organizzate dal Museo finalizzate alla raccolta di campioni mineralogici, nel tempo sono giunti in museo, per acquisti o donazioni, materiali provenienti da celebri viaggiatori che esplorarono aree del Mediterraneo. Grazie ai cataloghi settecenteschi e ottocenteschi e allo studio dei documenti storici, si sono potuti rintracciare, a distanza di 300 anni, numerosi esemplari entrati in Museo, in passato. Tra questi alcuni campioni raccolti dal celebre geologo Déodat de Dolomieu nel suo viaggio in Sicilia del 1781 e scambiati con esemplari del Museo nel 1788 (Rodolico 1960) (Fig. 7). Sono pochi esemplari: di questi, nelle attuali collezioni, si individuano solo campioni siciliani di zolfo nativo, spato pesante, allume e pietra bituminosa da varie miniere, San Cataldo, Capo d'Arso, Sciacca, Taormina. Negli archivi storici si trovano anche notizie della donazione nel 1790 da parte di Dolomieu di una serie di "prodotti vulcanici" non ben specificati e quindi non rintracciabili. Alla seconda metà del XVIII secolo risalgono anche i cinque campioni di rocce della Corsica, raccolti dallo studioso Pierre Barral nelle sue escursioni nell'isola (Breislak et al. 1789; Cipriani et al. 2005).



(Dolom:) Catalogue des objets contenus dans la caisse envoyé à Monsieur Fontana pour le Cabinet d'histoire naturelle de S. A. R. par M. le Commend. Dolomieu.

N° I. gros groupe de selenite ou gypse blanc crystallisé en longs prismes tronqués, demi transparents, entassés confusement les uns sur les autres. des mines de soufre de san Cataldo en Sicile.

N° 2. mine de soufre [illegible] par une crystallisation de gypse en gros prismes de la même mine.

N° 3. mine de soufre dans une gangue argilleuse et gypseuse, des mines d'azono en Sicile.

FIGURE 7. Detail of the first page of the Dolomieu list of specimens received at the Museum in 1788.

FIGURA 7. Particolare della pagina iniziale dell'elenco di campioni di Dolomieu, arrivati in Museo nel 1788.

Nelle collezioni della sezione di Mineralogia riveste particolare importanza la collezione di minerali dell'isola d'Elba, formatasi negli anni attraverso varie modalità di accesso, che costituisce una valida documentazione della ricchezza di specie mineralogiche e giacimenti che caratterizza la terza isola italiana. Vi sono confluiti i materiali di diversi raccoglitori, tra i quali la collezione di Giorgio Roster, acquistata dal Museo nel 1880, che insieme alla collezione Foresi ed esemplari già presenti in Museo, sono stati riuniti da Federico Millosevich nella "Collezione elbana", con il catalogo dal titolo "I 5000 elbani del Museo di Firenze" col sottotitolo "Contributo alla conoscenza della mineralogia dell'Elba" (1914). La raccolta Roster è costituita da circa 1800 esemplari ed è accompagnata dal catalogo originale (Fig. 8). In sei volumet-

FIGURE 8. Stunning specimen of pink tourmaline from Elba Island (Roster collection).

FIGURA 8. Splendido esemplare di tormalina rosa dall'Isola d'Elba (collezione Roster).

ti ben rilegati sono singolarmente descritti tutti i campioni, per lo più raccolti direttamente nelle escursioni. Le descrizioni, spesso accompagnate da magnifici disegni, sono sempre molto dettagliate; comprendono infatti: modalità di acquisizione, località descritta con grande dettaglio e inquadramento del deposito (Cipriani e Poggi 1994; Cipriani et al. 2003).

Su ogni campione, poi, era incollato un piccolo cartellino col numero, in nero se presente una sola specie, in rosso se le specie erano più di una. Nel complesso quindi non solo campioni splendidi, ma costituenti una collezione riccamente documentata, perfettamente ordinata e di altissimo valore scientifico.

Antropologia e etnologia

La sezione di Antropologia e Etnologia, nata il 28 novembre 1869 come Museo di Antropologia e Etnologia, ha raccolto materiali documentari delle popolazioni e delle culture dell'area mediterranea, grazie alla costante attività del suo primo direttore Paolo Mantegazza e degli studiosi che si formarono alla sua scuola.

Alla nascita del Museo, in seguito all'intercessione dell'allora Ministro dell'Istruzione Angelo Bargoni, molte istituzioni scientifiche inviarono a Mantegazza materiali di interesse antropologico, con lo scopo di radunare nel nuovo museo fiorentino quei reperti utili alla conoscenza delle popolazioni umane.

Fu così che si formarono le prime collezioni osteologiche, soprattutto crani, provenienti da ospedali, musei, biblioteche di diverse città italiane: già un anno dopo la fondazione del Museo si contavano più di 500 reperti. La attività di Mantegazza proseguì e fu tanto intensa da radunare una importante raccolta di reperti comprendenti resti umani dell'età neolitica, eneolitica, del Bronzo e del Ferro, circa 1200 crani etruschi e romani, importanti testimonianze della paleoantropologia italiana ed una collezione osteologica moderna di circa 2.300 esemplari provenienti da diverse regioni italiane, rara documentazione della variabilità delle popolazioni contemporanee.

Da scienziato polivalente ed eclettico quale era, Mantegazza si dedicò agli aspetti più disparati dello studio dell'Uomo e, accanto alle raccolte osteologiche, radunò nel suo Museo molti oggetti provenienti dalle campagne italiane, documentando aspetti diversi delle culture tradizionali rurali. Queste collezioni, insieme a nuclei di provenienza diversa, andarono a costituire una sezione particolare del Museo di Antropologia e Etnologia: il Museo Psicologico, con il quale l'antropologo si proponeva di studiare sentimenti, comportamenti e superstizioni del popolo italiano.

Mantegazza fu anche pioniere nell'utilizzo della fotografia come metodo di studio antropologico, metodologia che fu largamente adottata dai suoi discepoli e successori alla cattedra di Antropologia ed alla direzione del Museo, che conserva oggi un patrimonio di 25.000 stampe fotografiche e circa 6.700 negativi (Chiozzi 1996; Piccardi e Roselli 2000). Tra queste, più di 2.000 documentano i popoli della sponda meridionale del mediterraneo: Marocco, Algeria, Libia ed Egitto. La documentazione della Libia è di particolare interesse storico, ricalcando l'avventura coloniale dell'Italia in Tripolitania, Cirenaica e nel Fezzan dove, negli anni 1932–33, per incarico della Reale Società Geografica Italiana, venne effettuata una missione, condotta da Lidio Cipriani e Antonio Mordini, durante la quale furono scattate circa 1.700 immagini di tipi umani, paesaggi, abitazioni e incisioni rupestri (Cipriani 1933) (Figs. 9–13).

La stessa missione fu occasione di raccolta di materiale etnografico, un centinaio di oggetti documentari di aspetti diversi della cultura dei popoli di quelle regioni, ai quali si aggiungono collezioni di minore entità numerica ma non meno importanti per qualità, come il piccolo nucleo raccolto da Paolo Graziosi nel 1933 che comprende alcune collane-amuleto portate dai bambini. Accanto alle collezioni formatesi in seguito a spedizioni e viaggi di ricerca, vi sono ancora piccole

FIGURES 9–12 (left). Sulla sinistra le figure 9–12s.
FIGURE 9. Fezzan: Berber boy in front of his house. FIGURA 9. Fezzan: ragazzo berbero davanti alla porta della sua abitazione.
FIGURE 10. L. Cipriani with two Tuareg women. FIGURA 10. L. Cipriani con due donne tuareg.
FIGURE 11. Tuareg woman with child. FIGURA 11. Donna tuareg con bambino.
FIGURE 12. Libia: a street of Tripoli. FIGURA 12. Libia: strada di Tripoli.

raccolte frammentarie provenienti dalla Libia, effettuate per diletto da viaggiatori, esploratori, funzionari e militari dell'esercito coloniale, che in seguito furono donate al Museo (Graziosi 1940).

Per quanto riguarda gli altri paesi della sponda meridionale del Mediterraneo, la documentazione etnografica è di piccola entità, tuttavia vale la pena di segnalare un gruppo di oggetti in pelle (finimenti per cavallo, borse, custodie di armi) provenienti dal Marocco, dove furono raccolti nei primi anni del 1900 da Adolf Henry Savage Landor, instancabile viaggiatore e sensibilissimo artista, autore di centinaia di quadri e disegni e di numerosi libri sempre ispirati, sia gli uni che gli altri, alla vita quotidiana dei popoli lontani.

Dopo i viaggi legati al periodo coloniale, il Museo rinnoverà l'interesse verso i popoli dell'Africa mediterranea grazie a tre spedizioni che si susseguirono in Algeria nel 1975 e 1976 e nel 1980, organizzate dal Laboratorio di Ecologia del Quaternario (Istituto di Antropologia, Università di Firenze) e dirette dal Prof. Edoardo Borzatti von Löwenstern. A seguito di queste spedizioni il Museo si è arricchito di circa 150 oggetti appartenuti alle popolazioni Tuareg dell'Hoggar, regione montuosa dell'Algeria meridionale (Beritelli 1977; Borzatti von Löwenstern 1975). La collezione, formata da manufatti di cuoio e di legno, principalmente oggetti di uso quotidiano e da alcuni monili in argento, pettorali, fibbie, anelli bracciali, testimoniano di una cultura nata dall'incontro del mondo berbero con quello islamico.

ZOOLOGIA

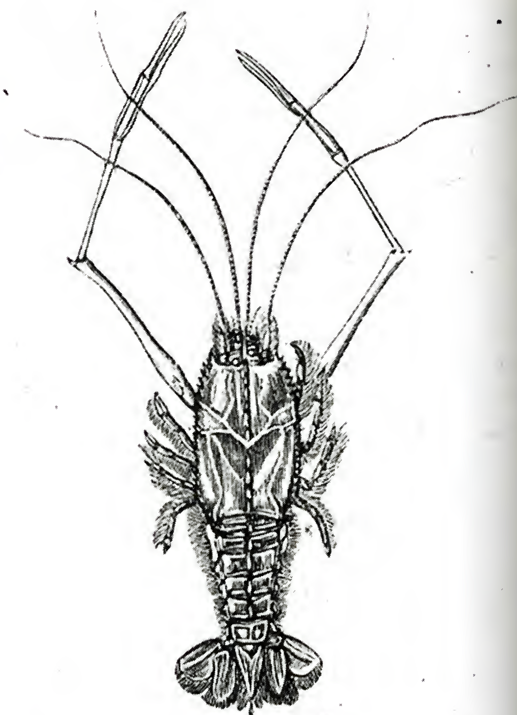
Anche presso la Sezione di Zoologia si conservano abbondanti materiali provenienti dal bacino del Mediterraneo, relativi un po' a tutti i gruppi animali.

È nella seconda metà dell'Ottocento che vennero compiute escursioni finalizzate allo studio di determinate aree per l'arricchimento delle collezioni. Questa tendenza iniziò con Adolfo Targioni Tozzetti che viaggiò in varie parti d'Italia per compiere raccolte sistematiche di molluschi, crostacei e zoofiti. Di particolare interesse il suo viaggio in Sardegna del 1868, con Piero Bargagli e Antonio Carruccio che portò alla raccolta di un ingente numero di Vertebrati e invertebrati da tutta l'isola (Carruccio, 1869).

È tuttavia ad Enrico Hillyer Giglioli (Fig. 13) che si debbono le principali spedizioni scientifiche nel Mediterraneo, compiute per incrementare la Collezione centrale degli Animali Vertebrati Italiani, fondata con criteri corologici per illustrare la fauna italiana con

FIGURE 13. Portrait of E. H. Giglioli.
FIGURA 13. Ritratto di E.H. Giglioli.

serie di esemplari provenienti da varie parti d'Italia. A scopo di raccolta visitò dapprima l'arcipelago Toscano e la Corsica poi, nel 1877, a bordo della goletta "Olga" esplorò il litorale del Lazio, della Campania, le Eolie, la costa orientale della Sicilia e il gruppo di Malta. Nel 1879 si dedicò alle coste nord-adriatiche del Veneto, dell'Istria e della Dalmazia e nel 1890, a bordo della nave "Marcantonio Colonna" compì il periplo della Sicilia e delle isole circumsiciliane (Barbagli & Violani 1996). Nel 1880 si svolse a Berlino l'esposizione internazionale della Pesca e già negli anni precedenti Giglioli si era adoperato per richiamare l'attenzione del governo sull'opportunità di impiegare un'unità del servizio idrografico della R. Marina per scandagliare e dragare il fondo del Mediterraneo. Le campagne inglesi del *Porcupine* e del *Shearwater* e francese del *Travailleur*, già compiute in precedenza nello stesso mare, non avevano acquisito dati positivi sulla presenza di vita animale a grande profondità ed avevano portato W.B. Carpenter a concludere che al di sotto di qualche centinaio di braccia il Mediterraneo fosse pressoché azoico. Giglioli, non convinto, come scienziato, dai risultati delle spedizioni straniere e animato, come italiano, da un sincero orgoglio nazionale, affinché anche l'Italia partecipasse attivamente agli studi talassografici, al ritorno da Berlino, si rivolse al ministro Miceli chiedendo "*se fosse possibile iniziare alcune ricerche intorno alla Fauna marina a grandi profondità con il R. Piroscafo Washington*". Trovato pieno appoggio anche dal comandante Giovan Battista Magnaghi, capo dell'Ufficio idrografico della Marina, la richiesta venne accolta e il 23 luglio 1881, Giglioli partì da Firenze per raggiungere la Maddalena, dove lo aspettava il *Washington* (Giglioli 1881a).



Willemoesia (Polycheles) *leptodactyla*, v. Will.-Suhm ($^1/_2$ di grand. nat.).

FIGURE 14. *Willoemesia leptodactyla* (=*Polycheles typhlops*): the first specimen of abissal fauna discovered in the Mediterranean Sea by E.H. Giglioli.

FIGURA 14. *Willoemesia leptodactyla* (=*Polycheles typhlops*): il primo esemplare di fauna abissale scoperto da E.H. Giglioli nel Mediterraneo.

I lavori talassografici durarono dal 1 agosto al 2 settembre, durante la rotta per Sciacca e l'Africa e la missione terminò il 6 settembre, con l'approdo a Genova. I dragaggi portarono in breve alla sensazionale scoperta della fauna abissale da lui intuita: il 4 agosto venne portato in superficie, da 2.150 metri di profondità, a nord-ovest dell'Isola di Asinara, un primo esemplare del crostaceo decapode *Willemoesia leptodactyla*, già noto per gli abissi dell'Atlantico (Giglioli 1881b) e nei giorni successivi alcuni pesci abissali, di cui due nuovi per la scienza.

La seconda campagna del *Washington*, progettata per l'agosto 1882, trovò delle difficoltà logistiche per la realizzazione dei previsti dragaggi abissali. Ciononostante, Giglioli si imbarcò e, pur compiendo due soli dragaggi, riscosse un discreto successo scientifico, portando alla luce un rarissimo pesce abissale, *Paralepis cuvieri*, e collaudando nuove attrezzature tecniche ideate dal Magnaghi. Durante l'attesa prima dell'imbarco, ad Agrigento, Giglioli effettuò scambi con il museo del liceo cittadino che gli fruttarono interessante materiale zoologico.

La terza campagna talassografica del *Washington* venne effettuata nell'agosto 1883, sotto il patrocinio della Regia Accademia dei Lincei ed era mirata a rilevamenti di carattere più fisico che biologico, seguendo la rotta verso Gibilterra con prelievi in profondità nello stretto e sulla costa atlantica del Marocco toccando infine Rabat. Purtroppo il poco tempo concesso alle dragate, limitate agli ultimi giorni, e le difficoltà tecniche, dovute alla perdita della draga principale, non permisero a Giglioli di estendere le sue ricerche sulla fauna abissale nel modo desiderato ed egli riuscì a compiere solo alcune osservazioni ornitologiche, ittiologiche e citologiche (Giglioli e Issel 1884).

I materiali marini raccolti nella campagna del *Washington* sono andati ad arricchire le collezioni del museo; Giglioli si è occupato direttamente solo dei Pesci, mentre gli altri gruppi zoologici sono stati studiati da specialisti nei rispettivi settori (Balducci 1912).

Nella campagna talassografica del 1884, rivolta allo studio delle correnti del Bosforo e dei Dardanelli, Giglioli non fu chiamato a partecipare; questa campagna sembra non aver lasciato segno, poiché risultati e materiali raccolti non vennero ne' studiati, ne' pubblicati.

Di lì a poco, senza alcun apparente motivo, la Commissione Talassografica venne sciolta e la nuova commissione insediata escluse Giglioli e il collega Targioni Tozzetti (Giglioli 1898).

Nell'anno successivo, sperando di rianimare l'interesse per questo tipo di studi, Giglioli pubblicò le proposte da lui presentate all'ultima riunione della Commissione talassografica, e anche in seguito, nel 1892 e nel 1895, approfittò dei primi due congressi geografici italiani per risollevare la questione (Giglioli e Issel 1885). In questa sede, pur riscuotendo un favore unanime da parte dei convenuti, la proposta cadde nel vuoto.

Anche altri personaggi legati al Museo ebbero comunque un significativo ruolo nell'esplorazione dell'area in questione, sia attraverso escursioni e raccolte mirate, come nel caso di Guelfo Cavanna in varie parti dell'Italia centro-meridionale, sia mediante prelievi occasionali e casuali come quelli di Vincenzo Baldasseroni a Castiglioncello, sia contribuendo allo sviluppo delle conoscenze scientifiche mediante lo studio sistematico del materiale raccolto da altri, come nel caso di Angelo Senna e Giuseppe Colosi che studiarono materiale raccolto durante spedizioni compiute da altri.

Già dalla metà degli anni '60 del secolo scorso Benedetto Lanza e suoi collaboratori avevano iniziato lo studio, prevalentemente erpetologico, delle piccole isole italiane, studio che si è poi esteso sia temporalmente, almeno fino ai primi anni '90, sia spazialmente, arrivando a interessare tutte le isole circumsarde (Poggesi et al. 1996), quelle intorno alla Corsica (Lanza e Poggesi 1986), le isole circumsiciliane (Corti et al. 1997) e alcune isole della Grecia.

Si ricollegano infatti a questo studio anche le crociere svolte, con il supporto del C. N. R., da ricercatori di varie università e enti scientifici italiani e da personale della sezione zoologica del Museo, negli anni '80 e '90. Queste furono svolte con l'appoggio delle navi *Minerva* e *Bannock*, che effettuarono più di dieci crociere.

In anni recenti (dal 1997) la sezione di Zoologia, insieme a quella di Botanica e all'Orto, ha realizzato (e sta tuttora aggiornandolo) il Repertorio Naturalistico Toscano (RE.NA.TO.), che raccoglie una grandissima massa di dati con l'obiettivo non solo di accrescere le conoscenze sul patrimonio naturale della Toscana, ma anche di conservarne e tutelarne la biodiversità, in particolare le specie e gli habitat in pericolo. Questo progetto regionale è un'estensione di progetti precedenti, anche nazionali, quali Bioitaly, o locali, 5-Bios, alla realizzazione dei quali queste sezioni del museo hanno partecipato (Sposimo e Castelli, 2005).

Negli ultimi due anni questo progetto di tutela si è esteso anche agli ambienti marini, per una valutazione ed individuazione di biocenosi vulnerabili, specie rare e *hotspot* di biodiversità in ambienti costieri di substrato duro (progetto BioMarT = Biodiversità Marina in Toscana); questo al fine di identificare aree marine di elevato interesse conservazionistico, le ipotesi per la loro

gestione e una prima mappatura degli habitat marini della Toscana, con la distribuzione di specie protette, rare o di particolare pregio. Infatti, allo stato attuale le conoscenze sugli ambienti marini della Toscana sono frammentarie e non organizzate, e pertanto poco accessibili. Alcune aree di elevato interesse naturalistico sono state individuate in passato e sono attualmente inserite nel Parco Nazionale dell'Arcipelago Toscano e in parchi regionali costieri (Migliarino-San Rossore-Massaciuccoli e Parco della Maremma).

Una ulteriore collaborazione continua dal 1997 a oggi, con l'istituto Israel Oceanographic and Limnological Research di Haifa (Israele), per lo studio di una specie di crostaceo decapode lessepsiano, *Charybdis longicollis*, abbondante nelle acque del Mediterraneo mediorientale (Galil and Innocenti 1999).

Tutte attività che oltre a portare avanti una tradizione plurisecolare di ricerche e scoperte permettono di continuare l'incremento delle collezioni del nostro Museo, che, a disposizione di studiosi e ricercatori permettono e permetteranno di fare ulteriormente progredire la conoscenza sul mare che ha visto la nascita della nostra cultura e degli studi sulla storia naturale.

Bibliografia

Arrigoni, P.V. 2006. *Flora dell'Isola di Sardegna*, vol. 1. Carlo Delfino editore, Sassari, Italia. 448 pp.

Baldini, R.M. 1990. Florula delle isole Formiche di Grosseto (Arcipelago Toscano). *Webbia* 44(2):271–278.

Baldini, R.M. 1991. Flora delle isole satelliti del Monte Argentario (Arcipelago Toscano). *Webbia* 46(1): 107–123.

Baldini, R.M. 1995. Flora vascolare del Monte Argentario (Arcipelago Toscano). *Webbia* 50(1):67–191.

Baldini, R.M. 1998. Flora vascolare dell'isola del Giglio (Arcipelago Toscano): revisione tassonomica ed aggiornamento. *Webbia* 52(2):307–404.

Baldini, R.M. 2000. Flora vascolare dell'isola di Pianosa (Arcipelago Toscano): revisione tassonomica ed aggiornamento. *Webbia* 55(1):107–189.

Balducci, E. 1912. Nota intorno all'ulteriore opera del Giglioli. Pagine 321–323 *in* E.H. Giglioli. Studi Talassografici. Annali dell'Agricoltura, Roma, Italia.

Barbagli, F., and C. Violani. 1996. Gli studi sulla Zoologia. – *In* Enrico Hillyer Giglioli: l'uomo, il naturalista, il viaggiatore. – *L'Universo* 76:634–653, 666–672.

Battistini, M. 1927. Giuseppe Casabona botanico fiammingo a sevizio dei Medici e le sue relazioni con Carlo Clusio. *Archivio Botanico per la Sistematica, Fitogeografia e Genetica* 3:191–202.

Beritelli, P. 1977. Oggetti Tuaregh portati dalla spedizione scientifica nell'Hoggar algerino e donati al Museo Nazionale di Antropologia di Firenze. *Archivio per l'Antropologia e l'Etnologia* 107:437–440.

Borzatti von Löwenstern, E. 1975. Una spedizione nel Sahara algerino. *Archivio per l'Antropologia e l'Etnologia* 105:292–293.

Breislak, S., B. Baral, and D. Dolomieu. 1789. *Beiträge zur Mineralogie von Italien*, Frankfurt, Germany.

Carruccio, A. 1869. Catalogo metodico degli animali vertebrati, riportati dalle escursioni nelle provincie meridionali, in Sicilia e in Sardegna, negli anni 1868–1869 dal cav. prof. Adolfo Targioni Tozzetti. *Atti della Società Italiana di Scienze Naturali* 12(3):553–586.

Caruel, T. 1860–1864. *Prodromo della Flora Toscana.* Le Monnier, Firenze, Italia. xxii + 767 pp.

Caruel, T. 1866. Supplemento al Prodromo della Flora Toscana. *Atti Società Italiana di Scienze Naturali* 8: 429–479.

Caruel, T. 1870. Secondo Supplemento al Prodromo della Flora Toscana. *Nuovo Giomale Botanico Italiano* 2:252–297.

Caruel, T. 1881. *Relazione del Prof. Teodoro Caruel al Soprintendente dell'Istituto sulla sistemazione delle collezioni botaniche corredate del disegno di massima dei nuovi locali destinati al Museo Botanico.* Le Monnier, Firenze. 11 pp., 1 table.

Cellai Ciuffi, G., and F. Fabbri. 1992. Guida alla visita del Giardino dei Semplici di Firenze. *Caryologia (Supplement)* 45(3–4):1–42.

Chiozzi, P. 1996. La "scuola fiorentina di Antropologia visuale". Pagine 13–16 *in* B. Chiarelli and P. Chiozzi,

eds., *Etnie. La scuola Antropologica fiorentina e la fotografia tra '800 e '900*, catalogo dell'omonima mostra, Alinari, Firenze, Italia.

Cipriani, C., and L. Poggi. 1994. Le collezioni del Museo di Mineralogia di Firenze: la formazione della collezione elbana. *Atti e Memorie Accademia La Colombaria* 59:165–184.

Cipriani, C., C. Nepi, and L. Poggi. 2000. Opuscoli e schede mineralogiche. Manoscritti e lettere di Ottaviano Targioni Tozzetti. Conoscenze naturalistiche a Firenze tra Sette e Ottocento. *Accademia Toscana di Scienze e Lettere "La Colombaria", Studi,* CLXXXVIII, Olschki ed. 130 pp.

Cipriani, C., L. Fantoni, G. Mazzetti, L. Poggi, and A. Scarpellini. 2003. Appunti per la storia del Museo di Storia Naturale dell'Università di Firenze. Le collezioni mineralogiche, nota II: un secolo di sviluppo(1844–1943). *Atti e Memorie Accademia La Colombaria* 68:299–336.

Cipriani, C., L. Fantoni, L. Poggi, and A. Scarpellini. 2005. Appunti per la storia del Museo di Storia Naturale dell'Università di Firenze. Le collezioni mineralogiche nota IV: i precursori. *Atti e Memorie Accademia La Colombaria* 70:155–224.

Cipriani, L., 1933. Missione antropologica nel Fezzan. *Archivio per l'Antropologia e l'Etnologia* 63: 331–333.

Corti, C., P. Lo Cascio, S. Vanni, G.F. Turrisi, and A. Vaccaro. 1997. Amphibians and reptiles of the circumsicilian islands: new data and some considerations. *Bollettino del Museo regionale di Scienze naturali di Torino* 15(1):179–211.

Cuccuini, P. 2003. La Xylothomoteca Italica: un caso insolito di serie di exsiccata. Catalogo e spigolature storiche. *Museologia Scientifica* 19(1) [2002]:97–119.

Cuccuini, P. 2003. The types of Italian Flora in the Herbarium Centrale Italicum (FI) in relation to the original collections and their founders. X OPTIMA Meeting. *Bocconea* 16(1):293–304.

Cuccuini, P., and C. Nepi. 1999. *Herbarium Centrale Italicum Phanerogamic Section: The Genesis and Structure of an Herbarium* (the main collections, the collectors, the handwriting samples and the personnel in its 150-year history). Giorgi & Gambi, Firenze, Italia. 463 pp.

Fabbri, F. 1963. L'Orto botanico di Firenze. *Agricoltura* 4:73–86.

Fabbri, F. 1964. Per una flora dell'Isola di Montecristo. Le piante vascolari raccolte da Alberto Chiarugi nel maggio del 1957. *Giornale Botanico Italiano* 70:629–633.

Fabbri, F. 1971. Isola di Montecristo. In: *Gruppo di Lavoro Conservazione Società Botanica Italiana, Censimento dei Biotopi di rilevante interesse vegetazionale meritevoli di conservazione in Italia.* 1, Forms 9–12. Savini-Mercuri, Camerino, Italia. 1–500 Forms.

Foggi, B., A. Grigioni, and P. Luzzi. 1999. La Flora vascolare dell'Isola di Capraia (Arcipelago Toscano): aggiornamento, aspetti fitogeografici e di conservazione. *Parlatorea* 5:5–53.

Foggi, B., and A. Grigioni. 1999. Contributo alla conoscenza della vegetazione dell'Isola di Capraia (Arcipelago Toscano). *Parlatorea* 3:5–33.

Foggi, B., M.A. Signorini, A. Grigioni, and M. Clauser. 2000. La vegetazione di alcuni isolotti dell'Arcipelago Toscano. *Fitosociologia* 37(1):69–92.

Fossi Innamorati, T. 1983. La flora vascolare dell'Isola d'Elba (Arcipelago Toscano). Parte prima. *Webbia* 36(2):273–411.

Fossi Innamorati, T. 1989. La flora vascolare dell'Isola d'Elba (Arcipelago Toscano). Parte seconda. *Webbia* 43(2):201–267.

Fossi Innamorati, T. 1991. La flora vascolare dell'Isola d'Elba (Arcipelago Toscano). Parte terza. *Webbia* 45(1):137–185.

Fossi Innamorati, T. 1994. La flora vascolare dell'Isola d'Elba (Arcipelago Toscano). Parte quarta. *Webbia* 49(1):93–123.

Galil, B.S., and G. Innocenti. 1999. Notes on the population structure of the portunid crab *Charybdis longicollis* Leene, parasitized by the rhizocephalan *Heterosaccus dollfusi* Boschma, off the Mediterranean coast of Israel. *Bulletin of Marine Sciences* 64(3):451–463.

Giglioli, E.H. 1881a. La scoperta di una fauna abissale nel Mediterraneo. *Atti del III Congresso Geografico Internazionale* 2:165–210.

Giglioli, E.H. 1881b. Italian deep-sea exploration in the Mediterranean. *Nature* 25:358.

Giglioli, E.H. 1898. Dell'opportunità che siano riprese in Italia le osservazioni e gli stdui talassografici. *Atti*

del III Congresso Geografico Italiano 2:3–10.

GIGLIOLI, E.H., AND A. ISSEL. 1884. *Pelagos. Saggi sulla vita e sui prodotti del mare*. Tip. Sordomuti, Genova, Italia. 436 pp.

GIGLIOLI, E.H., AND A. ISSEL. 1885. Proposte generali per l'esplorazione biologica completa del Mediterraneo e dei mari adiacenti, sottoposte alla Commissione talassografica. *Bollettino della Società Geografica Italiana* (2) 10:381–398.

GRAZIOSI, P. 1940. Graffiti rupestri a Sidi Alì nel Uadi El Agial (Fezzan). *Archivio per l'Antropologia e l'Etnologia* 70:75–80

LANZA, B., AND M. POGGESI. 1986. Storia naturale delle isole satelliti della Corsica. Universo: 66(1):2–200.

LUZZI, P., AND F. FABBRI. 1993. I Giardini dei Semplici e gli Orti Botanici della Toscana. Pagine 49–68 *in* S. Ferri and F. Vannozzi, eds., *Atti del Convegno di Siena* (7–9 maggio 1992). Qualtroemme, Perugia, Siena, Italia.

MICHELI, P.A. 1748. *Catalogus plantarum horti Cesarei Fiorentini*, Opus postumum, iussu Societatis Botanicae, editum, continuatum, et ipsius horti historia locupletatum ab Jo. Targionio Tozzettio, Florentiae, ex Typog. Bernardi Paperini. lxxxviii + 185 pp., 7 tables.

NEPI, C. 1997. Le Segnalazioni Floristiche Italiane dal 1978 al 1995: indici e commenti. *Informatore Botanico Italiano* 28:183–249.

NEPI, C. 2005. Gli erbari storici come bene culturale. Pagine 222–225 *in* G. Caneva, ed., *La Biologia Vegetale per i Beni Culturali, Conoscenza e Valorizzazione*, vol. II. Nardini Editore, Firenze, Italia. 504 pp.

PARLATORE, F. 1856. *Elogio di Philip Barker Webb*. Le Monnier, Firenze, Italia. 113 pp.

PARLATORE, F. 1874. *Les collections botaniques du Musée Royal de Physique et d'Histoire Naturelle de Florence au printemps du MDCCCLXXIV*. Imprimerie Successeurs Le Monnier, Firenze, Italia. 163 pp., 11 tables.

PICCARDI, M., AND M.G. ROSELLI. 2000. *Archivio fotografico. Catalogo dei fondi*. Università degli Studi di Firenze, Italia. 51 pp.

POGGESI, M., P. AGNELLI, M. BORRI, C. CORTI, P.L. FINOTELLO, B. LANZA, AND G. TOSINI. 1996. Erpetologia delle isole circumsarde. *Biogeographica* 18[1994]:583–618.

RAGAZZINI, S. 1993. *I manoscritti di P.A. Micheli conservati nella Biblioteca Botanica dell'Università di Firenze. Catalogo*. Inventari e Cataloghi Toscani/43. Giunta Regionale Toscana/Editrice Bibliografica, Firenze, Italia. xx + 99 pp.

RODOLICO, F. 1960. Richiamo al viaggio in Sicilia compiuto dal Dolomieu nel 1781. *Rivista Geografica Italiana* 67:1–4.

SPOSIMO, P., AND C. CASTELLI, EDS. 2005. *La biodiversità in Toscana. Specie e habitat in pericolo. Archivio del Repertorio Naturalistico Toscano* (*RENATO*). Regione Toscana Direzione Generale Politiche Territoriali e Ambientali, Tip. Il Bandino, Firenze, Italia. 302 pp.

TARGIONI TOZZETTI, A. 1841. *Catalogo delle piante coltivate nell'Orto Botanico Agrario detto dei Semplici*. Tipografia V. Batelli e Camp., Firenze, Italia. xi + 82 pp.

TARGIONI TOZZETTI, G. 1768–1779. *Relazioni di alcuni viaggi fatti in diverse parti della Toscana per osservare le produzioni naturali, e gli antichi monumenti di essa. Seconda edizione con copiose giunte*. 12 Voll. Stamperia Granducale per Gaetano Cambiagi, Firenze, Italia.

VISCONTI, A. 2004. The journeys of the Sicilian botanist Filippo Parlatore. *Proceedings of the California Academy of Sciences*, ser. 4, 55(Suppl. II; 4):29–41, 1 fig.

VV.AA. 2001. Piano d'azione per i Giardini Botanici nell'Unione Europea. *Informatore Botanico Italiano* 33: 1–63.

WWF, AND IUCN BCGI. 1989. *Botanic Gardens Conservation Strategy*. Italian Edition by the Orto Botanico, Dipartimento di Scienze Botaniche dell'Università di Pisa (1995). 63 pp.

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"Volcanic travels" and the Development of Volcanology in 18th Century Europe

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The aim of this paper is to provide an overview of the different ways of travelling through a volcanic region and studying a volcano - in order to describe its lithological, mineralogical and geological features - particularly in the second half of the 18th century. The early descriptions of Italian volcanoes were included in different kinds of printed works: "theories of the Earth" or theoretical interpretations of the "subterranean world", chronological repertoires of eruptions, publications based on travel of which geological observations were part and later fieldwork specifically undertaken in order to study the volcanoes. The increasing amount of data collected in the field during these travels in the Mediterranean region, as well as the changing methods of interpretations of the volcanic phenomena, also contributed to the European debate on the formation and on the age of the Earth's surface.

In the late 18th century, the development of volcanology as a scientific discipline was strongly influenced by the increase of the travels to the active Mediterranean volcanoes such as Vesuvius, Mt. Etna and the volcanoes of the Aeolian Islands. This research work followed the early studies on the so called 'ancient' or extinct volcanoes located in France, Italy, Bohemia and in other parts of Central Europe since the middle of the 18th century, but it was also the starting point of a larger series of explorations on the volcanic regions of Northern Europe, Southern America and Asia.[1] Several scientists and travellers gave a significant contribution to the studies of the Mediterranean volcanic phenomena in the late 18th and in the early 19th century: in particular, the names of William Hamilton (1730–1803), Déodat de Dolomieu (1750–1801), Lazzaro Spallanzani (1729–1799), Patrick Brydone (1743–1818), Michel-Jean comte de Borch (1751–1810), Scipione Breislak (1748–1826), Giovanni Battista Brocchi (1772–1826) and Leopold von Buch (1774–1853) may be recalled.[2]

The activity of volcanoes had attracted the interest of scholars since classical times. In the Mediterranean region, the first ideas of the ancient Greek and Romans on volcanic action were influenced by memories of the colossal 'Minoan eruption' of Santorini island (Thera) in the Aegean Sea, as well as by the long-standing activity of Mt. Etna and some of the Aeolian Islands (Vulcano and Stromboli) near Sicily, well before the catastrophic eruption of Vesuvius in 79 A.D.[3]

Later, the theory of the Earth proposed by Athanasius Kircher (1602–1680) in the second half of the 17th century provided some suggestions as to the role of volcanoes as one of the main elements for the functioning of the "geocosm" presented in the *Mundus Subterraneus*:[4] According to this theory, a central fire was connected to various fire filled chambers by numerous channels and the volcanic eruptions were regarded as safety valves against over-heating.[5] It was a theoretical system, but also based on the results of some travels in southern Italy, when Kircher had directly observed Stromboli and Etna in 1637, as well as Vesuvius in 1638 (Fig. 1). Moreover, the great cat-

astrophic eruptions of Vesuvius (1631) and Mt. Etna (1669), although they did not motivate long-distance travels, stimulated several scientific observations by local scholars. These works marked the beginning of a specific literature which continued to be very rich in the following centuries, including descriptions of the volcanoes, histories of their eruptions, but also interpretations of the volcanic phenomena and their dynamics.[6] In particular, the 1670 treatise *Historia et Meteorologia incendii Aetnaei anni 1669* (Fig. 2) by Giovanni Alfonso Borelli (1608–1679) was a fundamental step toward the birth of volcanology: volcanoes were still considered as safety valves, but Borelli recognized that local combustion inside the mountains melt rocks and sand in order to produce vitrified lava.[7]

FIGURE 1. Athanasius Kircher, Vesuvius observed in 1638 (in *Mundus Subterraneus*, Biblioteca Nazionale Centrale Roma, Fondo Gesuitico, Ms. 562, f. 509).

Descriptions of the eruptions of Vesuvius and Etna indeed represented the most considerable part of the 'volcanological' primary sources still in the early 18th century, but, after the works by Kircher and Borelli, theoretical explanations of the volcanic phenomena were also more often included in learned treatises about the 'subterranean world', such as for example the *Fisica Sotterranea* (1730) by the abbot Giacinto Gimma (1668–1735). He adopted the ancient theory of the earth 'as a sponge' with many subterranean caves and tunnels crossed by rivers of water or rivers of fire (as already illustrated by Kircher in the *Mundus Subterraneus*). This system of communicating rivers of fire was fed by combustible matter ("materie combustibili") and when one of these rivers arrived at the surface of the earth through an opening like the crater of a volcano, it caused an eruption. The *Fisica Sotterranea* was a detailed scholarly work, but clearly not based on travels or fieldwork.[8]

FIGURE 2. Mt. Etna after the 1669 eruption (from Borelli 1670; reproduced in Spallanzani 1792–97, vol. 1, plate I).

Ten years later, Anton Lazzaro Moro's (1687–1764) original theory of mountain building was expressed in the book *De' Crostacei*,[9] originally inspired by the impressive reports on the emergence in May 1707 of a new volcanic island near Santorini in the Aegean sea.[10] According to Moro, the 'primary' mountains were pushed up from the sea bottom by underground heat, like submarine volcanoes, and were composed of massive unstratified stone. The 'secondary' mountains, instead, were formed by strata deposited on the terrestrial surface by volcanic eruptions of the primary mountains during different ages. Consequently, all the mountains were products of the Earth's volcanic activity. This "volcanic" orogenesis had therefore essentially taken place within a great primitive ocean and was probably repeated during the Deluge and other floods. It is important to point

out that Moro had not accumulated much data collected in the field (and he never visited a 'volcanic' region), but he had instead expressed a precise theoric conviction based above all on the study of printed sources relative to various volcanic phenomena of the past and of the present, as according to him nature was uniform and always acted in a constant manner. This theory had an interesting diffusion within the Italian scientific community of the second half of the 18th century, but the limits of its excessive generalization were gradually emphasized by the geological results of the regional researches in the field, which in Italy drastically increased from the 1760s.

It seems therefore evident that from the late 17th to the middle of the 18th century, volcanoes were not usually the central subject of specific travels, but were included in general theories of the Earth without much fieldwork, studied by local scholars because of some catastrophic eruptions or casually observed during non-scientific travels. The latter case is well represented by the letter sent to King Charles II of England by Heneage Finch, 3rd Earl of Winchilsea (d. 1689), "late ambassador at Constantinople, who in his return from there, visiting Catania and the Island of Sicily, was an eye-witness of the dreadful spectacle", that is to say the Mt. Etna 1669 eruption (Fig. 3).[11]

FIGURE 3. The eruption of Mt. Etna in 1669 (in Winchilsea 1669).

Around the middle of the 18th century, more scientists began to examine those burnt rocks that resembled volcanic lavas and were sometimes found near to hills with conic shapes and crater-like tops, similar to small volcanoes. In the 1750s and 1760s, after several excursions in the south-eastern French region of Auvergne, Jean-Étienne Guettard (1715–1786) and later Nicolas Desmarest (1725–1815) announced that they had found traces of ancient extinct volcanoes, the evidence for which was the presence of rocks considered to be of igneous origin (formed by solidification from a molten state, like volcanic lavas), such as basalt.[12] The question of the origin of this latter type of rock had often puzzled geologists, especially because of the amazing regularity of the shape of the columnar basalts, which were large prismatic columns like those to be seen at the famous Giant's Causeway in the north of Ireland.[13]

It is well known that toward the end of the century, the question of the origin of basalt became one of the main elements of the controversy between the so-called Neptunists and Plutonists.[14] However, this controversy was preceded by a series of detailed field investigations that resulted in the discovery of extinct volcanoes and volcanic rocks in various regions of Europe, within a growing interest for the volcanic phenomena, although these were considered mainly as 'accidental' for the formation of the Earth's surface.[15] In Italy, for example, several important studies were carried out in the Venetian region between the 1750s and the 1770s by Giovanni Arduino (1714–1795) and by Alberto Fortis (1741–1803), as well as by the Briton John Strange (1732–1799).[16] In Tuscany similar studies were undertaken by Giovanni Targioni Tozzetti (1712–1783), on the footsteps of Pier Antonio Micheli (1679–1737), and later by Giorgio Santi (1746–1822), who travelled in the area of Monte Amiata, clearly recognized as being of volcanic origin.[17] These and other 'vulcanis-

tic' researches were promoted in Europe by influential scientists particularly involved in mineralogy, such as the German Rudolf Erich Raspe (1737–1794), the Austrian Ignaz von Born (1742–1791) and the Swedish Johann Jakob Ferber (1743–1790), who also travelled extensively in several countries of central and southern Europe.

In Italy, Giovanni Targioni Tozzetti was one of the main authors of an interesting collection of essays, *Dei Vulcani o Monti ignivomi più noti, e distintamente del Vesuvio*.[18] This work (Fig. 4) collected papers both about extinct and active volcanoes (with the exception of Mt. Etna) being studied in Italy by various 18th century scholars: it included several writings concerning Vesuvius, but also the extinct volcanoes in Tuscany and in Veneto. It was a significant example of a growing trend among the Italian scientists interested in the "volcanic" mountains and rocks where the comparison between lithological and morfological data collected in the field around active volcanoes and similar observations made in the places of supposed extinct volcanoes became gradually indispensable.

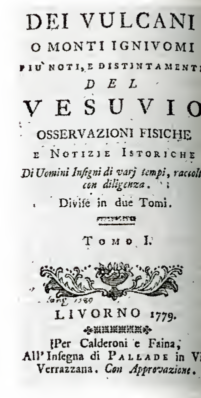
DEI VULCANI
O MONTI IGNIVOMI
PIU' NOTI, E DISTINTAMENTE
DEL
VESUVIO
OSSERVAZIONI FISICHE
E NOTIZIE ISTORICHE
Di Uomini Insigni di varj tempi, raccolte con diligenza.
Divise in due Tomi.
TOMO I.
LIVORNO 1779.
Per Calderoni e Faina,
All'Insegna di PALLADE in Via Verrazzana. *Con Approvazione.*

FIGURE 4. Title page of Targioni Tozzetti, 1779.

Lithological and chemical observations determined the recognition of old volcanic craters, such as the Solfatara of Pozzuoli,[19] or supported the idea that ancient volcanic activity had significantly changed the local geomorphology and had often altered the rock composition of some alpine and pre-alpine areas in the north-east of Italy[20] and in the Roman region called "Campagna Romana".[21] The rocks of the "colline vulcaniche" (volcanic hills) recognized in these areas were compared, for example, with those erupted by Vesuvius or found as part of the structure of an active volcano: in fact the demonstration of a melting process undergone by certain rocks was the proof of an ancient volcanicity.

As a consequence of these researches, several scientists at the end of the 18th century thought it necessary to describe in detail all the rock material found in the volcanic areas. Besides the well known works by Barthélemy Faujas de Saint-Fond (1741–1819),[22] the *Litologia Vesuviana* by Giuseppe Gioeni (1747–1822) was an interesting attempt to classify the volcanic rocks systematically in four units.[23] During the last thirty years of the 18th century, volcanoes became the subject of specific mineralogical and lithological studies, while travels to active volcanoes such as Vesuvius, Mt. Etna and the Aeolian Islands were undertaken by an increasing significant number of scholars and scientists. The establishment of a new kind of specific fieldwork linked to a travelling practice focused on the Earth sciences was also a consequence of a growing awareness about the existence of "empirical evidence related to the *rates* at which various natural processes could be seen operating; [...] Volcanoes provided some of the best evidence for such natural rates, and the most intensely discussed".[24] Southern Italy in particular, also with its region of ancient volcanoes (the Roman region, the Vesuvian region and some parts of Sicily) attracted several 'volcanic' travellers: among them William Hamilton (1730–1803), Déodat de Dolomieu (1750–1801) and Lazzaro Spallanzani (1729–1799) significantly contributed to establish and define the style of 'volcanic' travelling in the 1780s.[25]

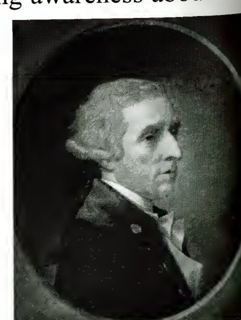

FIGURE 5. William Hamilton (1755–1797).

Sir William Hamilton (Fig. 5) was a scientist, antiquarian, collector and British envoy to the court of Naples:[26] in his successful book *Observation on Mount Vesuvius, Mount Etna and other volcanos* — published for the first time in 1772, then reprinted in 1773 and 1774 — he stated that "it was to establish a system, it would be, that Mountains are produced by Volcanoes, and not Volcanoes by Moun-

FIGURE 6. Hamilton, 1774, p. 42, plate I.

FIGURE 7. View of Stromboli drawn by Pietro Fabris (in Hamilton, 1776).

tains".[27] Hamilton travelled extensively in the Vesuvian area, climbed Vesuvius over 70 times, described some eruptions (such as that of 1767) (Fig. 6), visited Mt. Etna, and explored especially that large complex of craters and fumaroles located west of Naples, called the Phlegraean fields (Monte Nuovo and Solfatara). His collection of original papers and letters addressed to the Royal Society was published in the beautiful *in folio* volume *Campi Phlegraei*, enriched by a precious volume of coloured plates (Fig. 7).[28] Hamilton also realized that the historic recorded eruptions of an active and "so very ancient" volcano, such as Vesuvius or Etna, were just a small part of a much longer history: consequently, as Martin Rudwick has pointed out, "if the volcano had been built up by a succession of eruptions similar to those recorded through the centuries of human history, its total age must be vast beyond comprehension".[29]

FIGURE 8. Déodat Gratet de Dolomieu (1750–1801)

Dolomieu (Fig. 8), well known as a great geologist of the Alps,[30] travelled for the first time in southern Italy and visited the Vesuvian region in 1776, although his travel of 1781 was more distinctively volcanological, as he climbed Mt. Etna, explored the Aeolian islands and most of Sicily, including the extinct volcanoes of the Val di Noto.[31] Dolomieu's interest in Italian volcanoes determined the enlargement of his scientific correspondence and the establishment of personal relationships with Italian scientists such as Giuseppe Gioeni, Giovanni Arduino and Alberto Fortis. Moreover, Dolomieu's studies on active and extinct volcanoes were strictly linked to his original work on the structure of mountains within the 18th century debate on the 'classification' of mountain and rocks, according to the chronology of their formation.[32] For example, in the *Voyage aux Iles de Lipari*, Dolomieu described in detail the lithology of the Sicilian mountains called "*montes Neptunei*" (Péloritani mountains) in order to show the difference between the lavas of Etna (considered a mountain with a base of schists and granits) and the Aeolian islands (regarded as built on a base of granite) because "the study of mountains which are the base of volcanoes may be very useful for the theory of subterranean fires as well as the study of volcanoes themselves, and this aspect has been too much neglected in the past".[33]

Dolomieu did not believe that the volcanic mountains were formed only by strata of superimposed lavas, as theorized by Anton Lazzaro Moro and later by William Hamilton and Lazzaro Spallanzani. According to the French scientist, these were mainly primitive mountains deformed by volcanic forces which had mixed the erupted material (i.e. porphyry) with the rocks on the surface.[34] Consequently, according to Dolomieu the volcanic activity was a very important geological phenomenon which had modified the orography made of primitive and secondary mountains, but could not be regarded as a complete orogenetic phenomenon. Moreover Dolomieu considered the action of fire as essential for the formation of basalts studied on the Italian volcanic terrains and

defined as products of a cooling process in the sea-waters,[35] while some years later Spallanzani stated that the basaltic lavas could acquire the prismatic shape either because they condensed in the water or in the air: for example, some prismatic basalts observed on top of Vulcano in the Aeolian Islands were considered by Spallanzani the result of a process of cooling in the air of pieces of lava attached to the sides of a crater.[36]

Concerning the classification of volcanic products, in the *Mémoire sur les îles Ponces* (1788), Dolomieu published a *Tableau méthodique des productions de l'Etna*, according to the Linnean nomenclature, where rocks and minerals were subdivided in four classes ("productions" found during the eruptions; found during the calm periods; not modified by fire; other non volcanic products, but part of Etna's history), 12 genera, 40 species and several varieties. Finally Dolomieu stated that the quantity and complexity of Vesuvius' rock material was even greater than that from Etna. Consequently, volcanic productions were regarded in general as extremely varied and numerous, according to the different times and conditions of their formation. Moreover the volcanic activity was not considered a superficial fire, but instead a phenomenon which occurred in the deep structure of the terracqueous globe.

As Giovanni Arduino had stated some years earlier, Dolomieu believed that the combined action of fire and water was very important, if not essential, in the geological history of the Earth. Thus, at the beginning of the *Mémoire sur les volcans éteints du Val Noto en Sicile* we read that: "the two great agents of nature have worked in the mineral kingdom during the same times and in the same places in order to build the mountains; they have mixed their products and they have left certains proofs of their simultaneous action".[37]

The scientific methodology of Dolomieu, expressed through his researches on Italian volcanoes, adopted the essential elements of the late 18th century geology: the scientific travel and detailed fieldwork; the mineralogical skills and the practical knowledge of mining; the comparative study of mountains and volcanoes: "the study of mountains can spread more light on volcanoes, and the volcanoes themselves can be of great help for knowing the materials which are abundant in the center of the Earth. The excavations made by man for the exploitation of minerals are only small scratches on the surface of the globe and cannot be compared with the enormous cavities made by volcanoes".[38] The perception of the great complexity, number and variety of geological phenomena had moved Dolomieu away from the general theories of the Earth. He searched for the solution to the geological problems through travelling. This is the reason why, instead of referring to general theoretical models, he constantly introduced questions about problems that emerged from the fieldwork.

FIGURE 9. Johann Wolfgang Goethe (1749–1832).

The same careful attitude toward the theoretical 'systems' in geology was adopted by a different kind of scholar, but also scientist and traveller, such as Johann Wolfgang Goethe (1749–1832) (Fig. 9). In the *Italienische Reise*, the diary of the long Italian Journey undertaken between September 1786 and April 1788, published in two stages in 1817 and 1829, the observations on volcanoes and volcanic terrains throughout Italy, did not determine a substantial change in Goethe's neptunistic views and instead confirmed his idea that volcanoes were local phenomena whose fire was not linked to a common igneous source

FIGURE 10. Johann Wolfgang Goethe, The eruption of Vesuvius in 1787 (watercolour: Schloss-Museum. Weimar).

within the earth.[39] However, if, while exploring the Vesuvian area and climbing Vesuvius (Fig. 10) while in eruption, he had stated his familiarity with the rock-types (lava) observed at the flanks of the volcano, when in Sicily, he examined the remains of the 1669 lava flow of Mount Etna and noted that "remembering what passions had been aroused before I left Germany by the dispute over the volcanic nature of basalt, I chipped off a piece: it is a piece coming from a fusion without any doubt".[40]

Concerning the remains of extinct volcanoes, the Venetian area was only briefly mentioned by Goethe, who instead dedicated some pages to the "volcanic hills", "volcanic terrains" and "volcanic tufa" of the region of Rome, at that time less known and little investigated also by the Italian geologists. Compared to the Apennines, "these volcanic areas [near Rome] lie much lower, and it is only the water tearing across them which has carved them into extremely pictoresque shapes, overhanging cliffs and other accidental features".[41] In his Italian Journey, as well as in other scientific writings, Goethe often preferred to adopt a careful attitude of collecting and evaluating geological data, more than attempting general statements: on the other hand, he believed that in the history of naturalistic research, many observers had moved too quickly from the single phenomenon to the theory, which had often become insufficient and too hypothetical.

The most significant results of Lazzaro Spallanzani's (Fig. 11) geological researches were included in the *Viaggi alle Due Sicilie e in alcune parti dell'Appennino*, printed in Pavia from 1792 to 1797.[42] This impressive work in six volumes contains the reports of several travels in southern Italy and in the northern Apennines during the summer and autumn of the years 1788, 1789 and 1790. The entire second volume (1792) and about half of the third (1793) were devoted to the analysis of the geological and volcanological feautures of Lipari, Stromboli, Vulcano and other parts of the Aeolian Islands.[43] The reports on Mount Etna, Vesuvius and the Vesuvian area of Campi Flegrei were confined to the first volume (1792). The *Viaggi* soon also became available to non-Italian readers through various translations into French, German and English.[44]

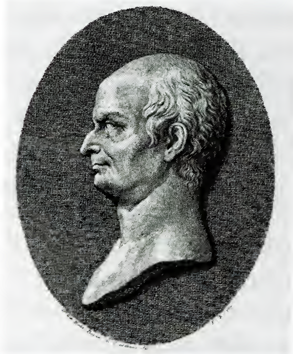

FIGURE 11. Lazzaro Spallanzani (1729-1799)

The first of these travels started in June 1788. During the following months Spallanzani paid particular attention to volcanic phenomena, as he had the possibility to observe Vesuvius and the Vesuvian area directly, to climb Mount Etna, and to study in detail the Aeolian Islands. Volcanoes are a constant presence in the first four volumes of the *Viaggi*, which contain all the geological observations carried out in southern Italy. Spallanzani himself had called this travel a "vulcanico viaggio" (volcanic journey) although its official purpose was to collect volcanic specimens for the Museum of Natural History of the University of Pavia.[45] In reality, Spallanzani's travel was also undertaken for pure research purposes, as demonstrated by his method of research in three successive stages, clearly inspired by Dolomieu's style of scientific travelling. Spallanzani's method included firstly the collection of information about previous literature on the subject of study; then a series of long, repeated and detailed observations in the field, with the compilation of lists of specimens; and finally several chemical experiments and analysis in the laboratory on the specimens collected (especially on the fusion of lavas or other volcanic rocks, also using glass furnaces). There is however a substantial difference between Spallanzani's and Dolomieu's views, as the latter did not believe it possible to recreate in the laboratory the real temperatures and the real conditions of a volcanic fusion because "we do not have any measure in order to know the degree of the fire we want to reproduce; its original intensity and activity is influenced by an infinity of circumstances which we cannot calculate".[46]

The content of the *Viaggi* shows Spallanzani's methodological approach in the vivid descriptions of the volcanic phenomena, in the detailed analyses of the observed lithological features, and in the reports of the experiments consequent to the travels made in the laboratories in Pavia, especially for determining the nature of lavas and the processes of melting and vitrification ("vetrificazione"). In fact, according to Spallanzani, the naturalist involved in the study of the rocks also needed an excellent chemical knowledge, because "the natural history of fossils[47] is so closely connected with modern chemistry, and the rapid and prodigious progress of the one so exactly keeps pace with that of the other, that we cannot separate them without great injury to both».[48]

Spallanzani was particularly interested in the geological and lithological structure of volcanoes. In the Introduction of the *Viaggi* he clearly stated the aim to study the volcanoes as mountains were generally studied by the "careful lithologists", that is to say with the investigation of the rock masses, including the position and the direction of the strata. This 'lithological' approach determined the insertion of many detailed descriptions of different kinds of rock and mineral specimens, as long digressions which often interrupted the main narration. For this reason Spallanzani was conscious that his *Viaggi* could not have been easy to read: nevertheless, he pointed out the need of the "circumstantial descriptions, which, in fact, form the basis of all solid science",[49] because the previous literature on the volcanic areas of southern Italy had rarely provided systematic lithological and mineralogical analyses. Moreover, Spallanzani considered both the exploration of the craters at the top of the volcanoes and the observation of the coastal features of the islands, where the erosion by the sea could have uncovered the internal lithological structure of the volcanic mountains, to be of equal importance.

According to Spallanzani, the orientation of the Aeolian Islands, in a straight line from east to west, showed a typical direction of the volcanic mountains, already noted for example in the little islands raised from the sea after the eruption of Santorini in 1707 or in the line of volcanic hills, which appeared during the eruption of Vesuvius in 1760. In this matter Spallanzani was probably also influenced by Dolomieu's hypothesis on a subterranean link between the volcanoes of the Aeolian Islands, Vesuvius, and Etna, as well as Dolomieu's interpretation that the volcanic arc of the islands near Ponza (with Ischia and Procida) was the connection between the region of active volcanism (Vesuvius and Campi Flegrei) and the region of the extinct volcanoes near Rome.[50] Consequently, the Italian scientist suggested that all the Aeolian Islands were probably raised contemporaneously from the sea and not in different ages.

Furthermore, the researches made in the Aeolian Islands confirmed Spallanzani's theory that the fire of volcanoes was probably caused by an enormous quantity of underground sulphur ("sulfuri di ferro") that was ignited by the presence of oxygen ("gaz ossigeno"); these investigations also contributed to reinforcing his conviction that volcanoes had gradually grown eruption after eruption until they became large mountains made of strata, such as Vesuvius or Etna (Fig. 12). Spallanzani concluded that "this certainly is the structure [origin] of almost all volcanic mountains. Their beginning is but small, and proportionate to the quantity of the first eruption; but as the succeeding eruptions increase in number and extent, they augment in size and solidity, till in time they acquire considerable dimensions".[51]

FIGURE 12. The main crater of Mt. Etna (in Spallanzani, 1792–97, vol. 1, plate II)

With the writings by Dolomieu and Spallanzani, the urgency of a new method of travelling and observing the volcanic terrains in the field in a different way from other mountain areas, became

definitively evident to the scientific community of the late 18th century. It is therefore significant that in his famous *Agenda* of instructions for making geological observations in the field, the Swiss scientist Horace Bénédict de Saussure (1740–1799), dedicated a full chapter to the study of volcanoes, where he recalled the difference between observations made during an eruption, on dormant and on possible extinct volcanoes.[52] Better known as an alpine traveller and geologist, Saussure had also travelled in the volcanic regions of southern Italy during the years 1772–73, while Hamilton was studying the Vesuvian area.[53]

At the turn of the century, within the geological controversy between Neptunists and Plutonists, not only new significant geochemical and lithological researches emerged,[54] but also the results of the 'volcanic' travels in the Mediterranean region had a great impact. The development of Italian geology and volcanology, for example, benefited greatly from the debate between Vulcanists and Neptunists or "Wernerians" at least up to the 1830s.[55] In the early decades of the 19th century, some former students of Werner at the Mining Academy of Freiberg such as Leopold von Buch, Alexander von Humboldt (1769–1859) and Jean-François d'Aubuisson de Voisins (1769–1841), as well as other less known European geologists, after some travels through the volcanic regions of southern Europe and South America began to revise their Wernerian ideas and accepted vulcanistic views that were more similar to those of the Plutonists.[56]

The 18th century heritage was recovered, discussed and analyzed in the light of the new theoretical positions on the study of volcanoes. New fieldwork was stimulated, mainly by the need to verify the range of applications of the emerging science of geology. When Charles Lyell (1797–1875) visited Mount Etna in 1828,[57] the 'volcanic travel' was certainly considered an indispensable part of the scientific study of the Earth's surface, but it was also becoming a significant tool for evaluating the great question of geological time.

BIBLIOGRAPHY

ARDUINO, G. 1775. Effetti di antichissimi vulcani osservati … nel mese di marzo 1769, nei monti della Villa di Chiampo, e in altri luoghi vicini del territorio di Vicenza. Pages 43–48 *in* G. Arduino, *Raccolta di Memorie Chimico-Mineralogiche, Metallurgiche e Orittografiche*. B. Milocco, Venezia.

ARDUINO, G. 1792. Circa gl'indizj d'antichissimi vulcani nelle montagne e Alpi Vicentine, Veronesi, e Trentine. *Memorie di Matematica e Fisica della Società Italiana*, 6:102–105.

ARRIGONI, T. 1987. *Uno scienziato nella Toscana del Settecento. Giovanni Targioni Tozzetti.* Gonnelli, Firenze, Italy. 173 pp.

ASHWORTH, W. B., Jr. 2004. *Vulcan's Forge and Fingal's Cave. Volcanoes, Basalt, and the Discovery of Geological Time.* Linda Hall Library, Kansas City, Missouri, USA. 96 pp.

BALDINI, M., B. BASILE, L. CONTI, T. LIPPARINI, E. MEZZACASA, G. PICCOLI, R. PIUTTI, P. PRETO, AND P. ROSSI. 1988. *Anton Lazzaro Moro (1687–1987)*. Grafiche Editoriali Artistiche Pordenonesi, San Vito al Tagliamento. 156 pp.

BORELLI, G.A. 1670. *Historia et meteorologia incendij Aetnaei Anni 1669. In* Officina Dominici Ferri, Regio Iulio [Reggio Calabria]. 162 pp.

BORELLI, G. A. 2001. *Storia e meteorologia dell'eruzione dell'Etna del 1669*, N. Morello, ed., Giunti, Firenze, Italy. 271 pp.

BREISLAK, S. 1786. *Saggio di osservazioni mineralogiche sulla Tolfa, Oriolo e Latera*. G. Zempel, Roma. 110 pp.

BULIFON, A. 1701. *Compendio istorico degli incendi del Monte Vesuvio fino all'ultima eruzione accaduta nel mese di giugno 1698*, A. Bulifon, Napoli. 152 pp.

CERBAI, I., AND C. PRINCIPE. 1996. *BIBV. Bibliography of Historic Activity on Italian Volcanoes*. IGGI- CNR, Pisa, Italy. 686 pp.

CIANCIO, L. 1995. *Autopsie della Terra. Illuminismo e geologia in Alberto Fortis (1741–1803)*. Olschki, Firenze, Italy. 385 pp.
CIANCIO, L. 1998. Giambattista Brocchi e la teoria dei vulcani sottomarini: conversione o ristrutturazione teorica? Pages 23–50 *in* E. Vaccari, ed., *Le scienze della Terra nel Veneto dell'Ottocento*. Istituto Veneto di Scienze, Lettere ed Arti, Venezia, Italy.
DEAN, D.R. 1998. Italian volcanoes and English observers. Pages 99–122 *in* MORELLO 1998a.
DE BOTTIS, G. 1786. *Istoria di varj incendi del monte Vesuvio* [second enlarged edition]. Nella Stamperia Regale, Napoli. 344 pp.
DELLA TORRE, G. M. 1768. *Storia e fenomeni del Vesuvio esposti dalla sua origine sino al 1767*. Campo Donato, Napoli. 120 + 39 pp.
DEN TEX, E. 1996. Clinchers of the basalt controversy: Empirical and experimental evidence. *Earth Sciences History* 15:37–48.
DOLOMIEU, D. Gratet de 1783. *Voyage aux îles de Lipari, fait en 1781; ou, Notices sur les Iles Aeoliennes pour servir à l'histoire des volcans*. Serpente / Sous le privilège de l'Académie Royale des Sciences, Paris. 208 pp.
DOLOMIEU, D. Gratet de 1784a. Mémoire sur les Volcans éteints du Val di Noto en Sicile. *Observations sur la physique, sur l'histoire naturelle et sur les arts* 15:191–205.
DOLOMIEU, D. Gratet de 1784b. Catalogue des produits volcaniques du Mount Ethna, joint à la collection des échantillons envoyés par M. le Chevalier de Dolomieu à M. le duc de la Rochefoucauld en 1782, et à M. Faujas de Saint-Fond. Pages 435–468 *in* FAUJAS DE SAINT-FOND 1784.
DOLOMIEU, D. Gratet de 1785a. Carte Oryctographique de l'Etna, dressée d'après les observations du chanoine J, Recupero, avec la Relation d'un voyage fait depuis peu sur ce volcan par M. le Commandeur de Dolomieu. Pages 90–104 *in* J.C.R. de SAINT-NON, *Voyage pittoresque ou Description des royaumes de Naples et de Sicile*. [Clousier], Paris, vol. 4, 1er partie.
DOLOMIEU, D. Gratet de 1785b. Description du volcan de Macaluba, ou Observation des phénomènes singuliers que présente une montagne de ce nom située près de Girgenti. Pages 336–346 *in* J.C.R. de Saint-Non, *Voyage pittoresque ou Description des royaumes de Naples et de Sicile*. [Clousier], Paris, vol. 4, 2e partie.
DOLOMIEU, D. Gratet de 1788. *Mémoire sur les îles Ponces, et catalogue raisonné des produits de l'Etna; pour servir à l'histoire des volcans: suivis de la description de l'éruption de l'Etna, du mois de juillet 1787. Ouvrage qui fait suite au Voyage aux îles de Lipari*. Cuchet, Paris. 525 pp.
DOLOMIEU, D. Gratet de 1790. Lettre […] sur la question de l'origine du basalte. *Observations sur la physique, sur l'histoire naturelle et sur les arts* 37:193–202.
ELLENBERGER, F. 1994. *Histoire de la Géologie. 2. La grande éclosion et ses prémices 1660–1810*. Lavoisier, Paris, France. 383 pp.
FAUJAS DE SAINT-FOND, B. 1778. *Recherches sur les volcans éteints du Vivarais et du Velay, avec un discours sur les volcans brulans, des mémoires analytiques sur les schorls, la zéolite, le basalte, la pouzzolane, les laves & les différentes substances qui s'y trouvent engagées, &c*. Cuchet, Grenoble et Paris. 460 pp.
FAUJAS DE SAINT-FOND, B. 1784. *Minéralogie des volcans, ou description de toutes les substances produites ou rejetées par les feux souterrains*. Cuchet, Paris, France. 511 pp.
FERBER, J.J. 1773. Osservazioni sopra la Zolfatara di Pozzuolo nel Regno di Napoli. *Giornale d'Italia* 9:94–99.
FOTHERGILL, B. 1969. *Sir William Hamilton. Envoy Extraordinary*. Harcourt, Brace & World, New York, New York, USA. 459 pp.
FORTIS, A. 1765. Descrizione Fisica de' Colli di Montegalda, luogo del Territorio Vicentino. *Giornale d'Italia* 1:83–86.
FRITSCHER, B. 1991. *Vulkanismusstreit und Geochemie. Die Bedeutung der Chemie und des Experiments in der Vulkanismus-Neptunismus-Kontroverse*. F. Steiner Verlag, Stuttgart, Germany. 346 pp.
GAUDANT, J., ED. 2005. *Dolomieu et la géologie de son temps*. École des Mines, Paris, France. 200 pp.
GEMMELLARO, C. 1858. *La vulcanologia dell'Etna. La topografia, la geologia, la storia delle sue eruzioni, la descrizione e lo esame de' fenomeni vulcanici*. Tipografia dell'Accademia Gioenia, Catania. 266 pp.
GIOENI, G. 1790. *Saggio di Litologia Vesuviana*. Stamp. Simoniana, Napoli. 208 pp.

GOETHE, J.W. 1947. *Die Schriften zur Naturwissenschaft*. Erste Abteilung: Texte. Band 1. *Schriften zur Geologie und Mineralogie 1770–1810*, edited by G. Schmid. H. Böhlaus, Weimar, Germany. 393 pp.

GIMMA, G. 1730. *Della Storia naturale delle Gemme, delle Pietre, e di tutti i Minerali, ovvero della Fisica Sotterranea*. Nella Stamperia di Gennaro Muzio, Napoli. 2 vols.

GOREE, (FATHER) 1711. A Relation of a New Island, Which Was Raised up from the Bottom of the Sea, on the 23d of May 1707. in the Bay of Santorini, in the Archipelago. Written by Father Goree (a Jesuit) an Eye-Witness. *Philosophical Transactions* 27(1710–1712):354–375.

GREENE, M.T. 1982. *Geology in the Nineteenth Century. Changing Views of a Changing World.* Cornell University Press, Ithaca, Neew York, USA and London, UK 324 pp.

HAMILTON, W. 1774. *Observations on Mount Vesuvius, Mount Etna, and Other Volcanos*. Cadell, London. 179 pp.

HAMILTON, W. 1776. *Campi Phlegraei. Observations on the Volcanos of the Two Sicilies*. Fabris, Naples. 2 vols.

HAMILTON, W. 1779. *Supplement to the Campi Phlegraei Being an Account of the Great Eruption of Mount Vesuvius in the Month of August 1779*. Fabris, Naples. 44 pp.

HAMM, E.P. 1991. Goethe's morphology of stones: between natural history and historical geology. Pages 329–338 *in* W.R. Woodward and R.S. Cohen, eds., *World Views and Scientific Discipline Formation*. Kluwer, Dordrecht, Netherlands.

KIRCHER, A. 1664–65. *Mundus subterraneus, in XII Libros digestus*. J. Janssonium & E. Weyerstraten, Amsterdam, Netherlands. 346 pp.

KNIGHT, C. 1990. *Hamilton a Napoli*. Electa, Napoli, Italy. 215 pp.

LACROIX, A. 1918. Un voyage géologique en Sicile en 1781: notes inedites de Dolomieu, *Bulletin de la Section de géographie du Comité des travaux historiques et scientifiques*: 29–213.

LACROIX, A. 1921. *Déodat Dolomieu, membre de l'Institut National (1750–1801). Sa vie adventureuse - sa captivité - ses ouvres - sa correspondance*. Perrin, Paris, France. 2 vols.

MOORE, D.T. 1994. Sir William Hamilton's volcanology and his involvement in Campi Phlegraei. *Archives of Natural History* 21(2):169–193.

MORELLO, N. ED. 1998a. *Volcanoes & History. Proceedings of the 20th INHIGEO International Symposium 19–24 September 1995*. Brigati, Genova, Italy. 753 pp.

MORELLO, N. 1998b. Giovanni Alfonso Borelli and the eruption of Etna in 1669. Pages 395–413 *in* Morello 1998a.

MORELLO, N. 2001. Nel corpo della Terra. Il geocosmo di Athanasius Kircher. Pages 179–196 *in* E. Lo Sardo, ed., *Athanasius Kircher. Il museo del mondo*. Edizioni De Luca, Roma, Italy.

MORO, A.L. 1740. *De' crostacei e degli altri marini corpi che si truovano su' monti*. S. Monti,Venezia. 452 pp.

NUMMEDAL, T. E. 2001. Kircher's subterranean world and the dignity of geocosm. Pages 37–47 *in* D. Stolzenberg, ed., *The Great Art of Knowing. The Baroque Encyclopedia of Athanasius Kircher*. Stanford University Press, Stanford, California, USA.

PALMIERI, L. 1880. *Il Vesuvio e la sua storia*. Tipografia Faverio, Milano, 79 pp.

PRINCIPE, C. 1999. Volcanology by the end of the XVIIIth century through the writings of Lazzaro Spallanzani, Déodat de Dolomieu and William Hamilton. Pages 319–342 *in* W. Bernardi and M. Stefani, eds., *La sfida della modernità. Atti del Convegno Internazionale di Studi nel bicentenario della morte di Lazzaro Spallanzani*. Olschki, Firenze, Italy.

RECUPERO, G. 1815. *Storia naturale e generale dell'Etna*. Stamperia della Regia Università, Catania. 2 vol.

RUDWICK, M.J.S. 1969. Lyell on Etna, and the antiquity of the Earth. Pages 288–304 *in* C.J. Schneer, ed., *Toward a History of Geology*. MIT Press, Cambridge, Massachusetts, USA and London, UK.

RUDWICK, M.J.S. 2005. *Bursting the Limits of Time. The Reconstruction of Geohistory in the Age of Revolution*. The University of Chicago Press, Chicago, Illinois, USA and London, UK. 708 pp.

SANTI, G. 1795. *Viaggio al Montamiata*. R. Prosperi, Pisa. 356 pp.

SAUSSURE, H.B. de 1776. Lettre à son Excellence M. Le Chevalier Hamilton, Ministre Extraordinaire et Plénipotentiaire de sa Majesté Britannique à Naples, du 17 Décembre 1774 [Sur la géographie physique de

l'Italie]. *Observations sur la Physique sur l'Histoire Naturelle et sur les Arts* (Paris) 7:19–38.

SAUSSURE, H. B. de 1796. Agenda ou Tableau général des Observations et des Recherches dont les résultats doivent servir da base à la théorie de la Terre. § 2304–2327 *in* H. B. de Saussure, *Voyages dans les Alpes.* Neuchâtel, L. Fauche-Borel, vol 4. [also published in *Journal des Mines* (Paris) 4(20):1–70]

SIGRIST, R. ED. 2001. *H.-B. De Saussure (1740–1799). Un regard sur la Terre*. Georg, Genève. 544 pp.

SIGURDSSON, H. 1999. *Melting the Earth. The History of Ideas on Volcanic Eruptions*. Oxford University Press, New York, New York, USA and Oxford, UK. 260 pp.

SLEEP, M.C.W. 1969. Sir William Hamilton (1730–1803): his work and influence in geology. *Annals of Science* 25:319–338.

SORRENTINO, I. 1734. *Istoria del Monte Vesuvio*. G. Severini, Napoli. 224 pp.

SPALLANZANI, L. 1792–97. *Viaggi alle Due Sicilie e in alcune parti dell'Appennino*. B. Comini, Pavia, 6 vol.

SPALLANZANI, L. 1798. *Travels in the Two Sicilies, and some parts of the Apennines*. G.G. & J. Robinson, London, England. 4 vols.

SPALLANZANI, L. 2006–07. *Viaggi alle Due Sicilie e in alcune parti dell'Appennino* [1792–1797], edited by E. Vaccari. Edizione Nazionale delle opere di Lazzaro Spallanzani. Opere edite direttamente dall'Autore, Parte Quarta, Volume Sesto. Tomi I–II, Mucchi, Modena, Italy. 849 pp.

TARGIONI TOZZETTI, G. 1768–79. *Relazioni d'alcuni viaggi fatti in diverse parti della Toscana* [second enlarged edition]. Cambiagi, Firenze. 12 vols.

TARGIONI TOZZETTI, G. 1779. *Dei Monti ignivomi della Toscana e del Vesuvio*. Pages VII–LIX in *Dei Volcani, o monti ignivomi più noti, e distintamente del Vesuvio. Osservazioni fisiche e Notizie Istoriche de Uomini Insigni di varj tempi, raccolte con diligenza*. Calderoni e Faina, Livorno, vol. 1.

TAYLOR, K.L. 1969. Nicolas Desmarest and geology in the 18th century. Pages 339–356 *in* C. Schneer, ed., *Toward a History of Geology*. MIT Press, Cambridge, Massachusetts, USA.

TAYLOR, K.L. 1998. Volcanoes as accidents: how 'natural' were volcanoes to 18th century geologists? Pages 595–618 *in* MORELLO 1998a.

TAYLOR, K.L. 2007. Geological travellers in Auvergne, 1751–1800. Pages 73–96 *in* P.N. Wyse Jackson, ed., *Four Centuries of Geological Travel*. Geological Society of London – Special Publications 287.

VACCARI, E. 1993. *Giovanni Arduino (1714–1795). Il contributo di uno scienziato veneto al dibattito settecentesco sulle scienze della Terra.* Olschki, Firenze, Italy. 408 pp.

VACCARI, E. 1998a. Lazzaro Spallanzani and his geological travels to the "Due Sicilie": the volcanology of the Aeolian Islands. Pages 621–652 *in* MORELLO 1998a.

VACCARI, E. 1998b. Mineralogy and Mining in Italy between eighteenth and nineteenth centuries: the extent of Wernerian influences from Turin to Naples. Pages 107–130 *in* B. Fritscher and F. Henderson, eds., *Toward an History of Mineralogy, Petrology and Geochemistry.* Institut für Geschichte der Naturwissenschaften, München ("Algorismus", Heft 23).

VACCARI, E. 1999. Alcune riflessioni sul contributo di Spallanzani alle scienze della Terra del Settecento. Pages 137–162 *in* W. Bernardi and P. Manzini, eds., *Il cerchio della vita.* Olschki, Firenze, Italy.

VACCARI, E. 2000. Spallanzani e le scienze geologiche del Settecento: un percorso interpretativo tra carteggi e diari di viaggio. Pages 293–317 *in* W. Bernardi and M. Stefani, eds., *La sfida della modernità. Atti del Convegno di Studi nel bicentenario della morte di Lazzaro Spallanzani*. Olschki, Firenze, Italy.

VACCARI, E. 2003. Wernerian Geognosy and Italian Vulcanists. Pages 26–35 *in* H. Albrecht and R. Ladwig, eds., *Abraham Gottlob Werner and the Foundation of the Geological Sciences*. Freiberger Forschungshefte, D 207 Montan und Technikgeschichte, Freiberg, Germany.

VACCARI, E. 2005a. Dolomieu et les volcans d'Italie. Pages 87–94 *in* GAUDANT 2005.

VACCARI, E. 2005b. Tra Nettunismo e Vulcanismo. Gli studi geologici di Goethe e il 'Viaggio in Italia'. Pages 417–446 *in* G.F. Frigo, R. Simili, F. Vercellone and D. von Engelhardt, eds., *Arte, scienza e natura in Goethe*. Trauben, Torino, Italy.

VACCARI, E. 2006. The "classification" of mountains in eighteenth century Italy and the lithostratigraphical theory of Giovanni Arduino (1714–1795). Pages 157–177 *in* G.B. Vai and W.G.E. Caldwell, eds., *The Origins of Geology in Italy*. Geological Society of America, Special Paper 411.

VACCARI, E. 2007. The organized traveller: scientific instructions for geological travels in Italy and Europe

during the eighteenth and nineteenth centuries. Pages 7–17 *in* P.N. Wyse Jackson, ed., *Four Centuries of Geological Travel*. Geological Society of London – Special Publications 287.

VASOLI, C. 1970. L'abate Gimma e la "Nova Encyclopaedia" (Cabbalismo, lullismo, magia e "nuova scienza" in un testo della fine del Seicento. Pages 787–846 *in Studi in onore di Antonio Corsano*. Lacaita Editore, Manduria, Italy.

WINCHILSEA, H. FINCH, EARL OF. 1669. *A true and exact relation on the late prodigious earthquake and eruption of mount Ætna, or, Monte-Gibello ... Together with a more particular narrative of the same, as it is collected out of several relations sent from Catania*. T. Newcomb in the Savoy, London. 30 pp.

ZANZI L. 2003. *Dolomieu. Un avventuriero nella storia della natura*. Jaca Book, Milano, Italy. 559 pp.

NOTES

1 Morello, 1998a.

2 On the wide literature on this topic, between the 17th and 19th century, see Ashworth, 2004.

3 Sigurdsson, 1999:21–50.

4 Kircher, 1664–65.

5 On Kircher's *Mundus Subterraneus*, see Morello, 2001 and Nummedal, 2001.

6 See in particular Bulifon, 1701; Sorrentino, 1734; Della Torre, 1768, De Bottis, 1786; Recupero, 1815; Gemmellaro, 1858; Palmieri, 1880. More references in Cerbai & Principe, 1996.

7 Borelli, 1670 (also published, with Italian translation and notes by N. Morello, in Borelli, 2001). For a complete analysis of this work, see Morello, 1998b.

8 Gimma, 1730. On this Italian scholar, see Vasoli, 1970.

9 Moro, 1740. On Moro, see Baldini et al., 1988.

10 See in particular Goree, 1711.

11 Winchilsea, 1669. On this author see Dean, 1998:105–107.

12 Ellenberger, 1994:218–245: on Desmarest see also Taylor, 1969, and Rudwick, 2005:203–214. On the geological travellers in Auvergne during the second half of the 18th century, see Taylor, 2007.

13 On this debate, see Den Tex, 1996.

14 Ellenberger, 1994:265–267.

15 This interpretation has been proposed by Taylor, 1998.

16 On these scientists, see Vaccari, 1993 and Ciancio, 1995.

17 Targioni Tozzetti, 1768–79; Santi, 1795: on Targioni Tozzetti, see Arrigoni, 1987.[18] See his paper in Targioni Tozzetti, 1779.

19 Ferber, 1773.

20 Arduino, 1775, 1792 and Fortis, 1765.

21 Breislak, 1786.

22 See in particular Faujas de Saint-Fond, 1778, 1784.

23 Gioeni, 1790.

24 Rudwick, 2005:118–119. Rudwick also well defines the importance of "firsthand outdoor fieldwork" for the late 18th century geologists (see pages 41–44).

25 Principe, 1999.

26 On this scholar see Fothergill, 1969; Sleep, 1969 and Knight, 1990.

27 Hamilton, 1774:161.

28 Hamilton, 1776; 1779: on this work see Moore, 1994. On Hamilton's ideas on Vesuvius and Etna, see Rudwick, 2005:119–122.

29 Rudwick, 2005:120–121.

30 Besides the classic biography by Lacroix, 1921, see the recent studies by Zanzi, 2003; Gaudant, 2005; Rudwick, 2005:317–325.

31 See Dolomieu, 1783, 1784a, 1784b, 1785a and 1785b. Dolomieu's unpublished notes on this travel have been studied by Lacroix, 1918. On Dolomieu's studies of Italian volcanoes, see Vaccari, 2005a.

32 On this subject see Vaccari, 2006.

33 Dolomieu, 1783:127. "L'étude des montagnes sur la base desquelles reposent les volcans, peut instruire le

Naturaliste sur la théorie des feux souterrains, autant que l'étude des volcans eux-mêmes; ce point de vue a été trop negligé jusqu'à present."

34 Dolomieu, 1783:130.

35 Dolomieu 1790:198.

36 Spallanzani, 1792–97: vol. 2, 192; vol. 3, 182–192.

37 Dolomieu 1784:191. "Les deux grands agents de la Nature dans le règne minéral y ont travaillé dans le même temps et dans les mêmes lieux à la formation des montagnes; ils ont melé leurs produits et y ont laissé des preuves certaines de leur action simultanée."

38 Dolomieu, 1783:130–131. "Mais l'étude des montagnes peut répandre beaucoup de lumières sur les volcans, les volcans eux-mêmes peuvent être d'un très-grand secours pour connoître les matières qui se trouvent les plus abondamment dans le centre de la terre. Les excavations et les approfondissemens que les hommes font pour l'extraction des minéraux, ne sont que des égratignures sur la surface du globe, lorsqu'on les compare aux cavités immenses qu'ont formées les volcans, en élevant des masses aussi enormes que le sont les montagnes qu'ils ont produites".

39 On Goethe's geological studies see Vaccari, 2005b and Hamm, 1991.

40 Goethe, 1947:158. "Ich schlug ein unbezweifeltes Stück des Geschmolzenen herunter, bedekend, dass vor meiner Abreise aus Deutschland schon der Streit über die Vulkanität der Basalte sich entzündet hatte".

41 Goethe, 1947:137. "Die vulkanischen Strecken sind viel niedriger als die Apenninen und nur das durch-reisende Wasser hat sie zu Bergen und Felsen gemacht; da sind aber schöne gegenstände, überhägende Klippen".

42 Spallanzani,1792–97: now reprinted in Spallanzani, 2006–07. On Spallanzani's geological studies, see Vaccari, 1999, 2000.

43 Vaccari, 1998a.

44 See the English translation in Spallanzani, 1798.

45 Spallanzani, 1792–97, vol. 1:xi–xii.

46 Dolomieu, 1783:127–128. "Nous n'avons aucune mesure pour connoître le degré du feu que nous employons; son intensité et son activité tiennent à une infinité de circonstances que nous ne pouvons calculer".

47 At the end of the 18th century this term were still used for indicating all the inorganic objects which were found within the Earth's surface.

48 Spallanzani, 1798, vol. 1:xxv, translation of Spallanzani, 1792–97, vol. 1:xxxi: "la Storia naturale dei Fossili è sì strettamente legata alla Chimica d'oggigiorno, e i rapidi e prodigiosi avvanzamenti dell'una camminano sì del pari, e sì concordemente cospirano con quelli dell'altra, che separar non possiamo la prima dalla seconda senza notabile danno di entrambe".

49 Spallanzani, 1798, vol. 1:xvii, translation of Spallanzani, 1792–97, vol. 1:xx–xxii: "particolarizzate descrizioni, le quali infine formano la base d'ogni solido sapere".

50 Dolomieu, 1783:139–141: *Communication des volcans de Lipari avec l'Ethna et le Vésuve.*

51 Spallanzani, 1798, vol. 2:152, translation of Spallanzani, 1792–97, vol. 2:137–138: "Questa certamente è la genesi di quasi tutti i Monti vulcanici. Da principio sono tenue cosa, proporzionati cioè alla mole della prima eruzione. In ragione poi del numero, e dell'estensione di queste, si aumentan di massa e di volume, e a capo di tempo aquistano considerabile ampiezza". It must be noted that the Italian word "genesi" (genesis, birth, origin) has been not properly translated in English with the word "structure".

52 Saussure, 1796: § 2322. On this work and its role for the development of the geological travel, see Vaccari, 2007:10–12. On Saussure, see Sigrist, 2001.

53 Saussure, 1776.

54 As demonstrated by Fritscher, 1991.

55 See Vaccari, 1998b, 2003.

56 Greene, 1982:62–68. See also the case of the Italian Giambattista Brocchi, analyzed in Ciancio, 1998.

57 Rudwick, 1969.

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The Naturalistic Explorations of the Milanese Barnabite Ermenegildo Pini (1739–1825) Along the Coast of Calabria: New Observations and Implications with Regard to His Views on the History of the Earth

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When the naturalist Ermenegildo Pini[1], a Barnabite cleric of the Sant'Alessandro College in Milan, began his travels at the beginning of July 1792[2] along the Italian Peninsula as far as the coast of upper Calabria, his knowledge of geology and mineralogy had already been consolidated for some time.

FIGURE 1. Ermenegildo Pini. Biblioteca Ambrosiana Milano.

Born in Milan in 1739, Pini studied at the Barnabite schools of Monza and Milan and took his vows in October 1757. Between 1757 and 1760 he studied philosophy and geometry and later went to Rome where he was conferred with a degree in theology. He returned to Milan in 1764 and was assigned to the college of Sant'Alessandro. He was nominated professor of Canon Law in 1765 and later also taught mathematics. Apart from his teaching activities, he began a promising career as an architect, which culminated in the writing of an important treatise[3] and in the project for the imposing dome of the parish church of San Giuseppe di Seregno[4]. In 1773 he was, nevertheless, suddenly required by the Barnabite Order to abandon his theological-mathematical-architectual career in order to dedicate himself to naturalistic disciplines[5]. The Hapsburg empire had in fact decided to establish a museum and a chair for Natural History in Milan with the aim of collecting rock, mineral, plant, and animal specimens, which could be useful from an ecomical-practical and didactic point of view. The management of these institutions was entrusted to the Barnabite Order, which, in turn, entrusted the directorship to Pini[6]. In order to master the knowledge necessary for the realization of the tasks before him, he first went to Vienna and later undertook various scientific travels in Austria, central Italy, Piedmont, Savoia, Switzerland, and to Mt. St. Gotthard. In addition, he made many short excursions within the mountains of Austrian Lom-

bary in order, firstly, to collect natural objects and, secondly, to initiate research on new mineralogical sites and to improve the level of work at existing sites[7]. Over the years, he intensified his activities, above all after his nomination as Delegate of Mines (1782)[8], a post that became fundamental both for the economic growth of Austrian Lombardy[9], and for the expansion of the Museum of Sant'Alessandro[10].

Alongside these accomplishments, Pini undertook his first naturalistic studies, which were mainly oriented towards the problems posed by orographic questions and, in particular, by the structure, morphology, and height of the mountains. His first scientific work on the subject, written after his travel in Lombardy and Piedmont in 1779[11], was emblematic. In addition to the petrographic and mineralogical description of the material collected in the mountains of that area, he also presented some thoughts or ideas indicative of his view on the litho-stratigraphic questions frequently debated by geologists at this time. This work also showed his orientation in favour of a primordial ocean, which initially had covered the entire planet. In this regard, his reflections are of particular interest as they were mainly in agreement with the ideas of the German traveler and naturalist Peter Simon Pallas with reference to the granite formation of the highest mountains and the absence of granite strata[12]. However, he did not ignore the doubts expressed on the topic by the Swiss naturalist Horace-Bénédict de Saussure who was inclined not to completely exclude the possibility of stratification in the granite[13]. Furthermore, his position with respect to the presence of granite formations in the middle and low mountains was based on the descriptions by the German geologist Johann Friedrich Wilhelm Charpentier and on those of the mineralist of Swedish origin, Johann Jacob Ferber[14], to which he added his own new observations. Finally, he adhered to the studies by the Swedish chemist Torbern Olof Bergmann concerning the distinction of the mountains into primary (or rather granitic), i.e., created together with the Earth, and secondary, i.e., formed either by water (such as the limestones), or by fire.[15]

This promising first dissertation was followed by several essays aimed at developing the study of orogenetic and orographic questions through the interconnection of mathematical reasoning and naturalistic observations made *in loco*. Regarding this subject, a good example is the memoir on the disposition of strata of 1780[16], in which he described the possibility of recognising the presence of strata and of determining their inclination and direction by using a "gonimeter", an instrument adjusted by him for that purpose. In his work on the height of the mountains of Lombardy in 1781[17], he presented the results of the measurements he had done for determining the absolute and relative heights of the mountains of Lombardy. On this basis, he thus attempted to establish a first general division between the high granite and quartzose reliefs, characterized by the presence of fractures and fissures on the one hand, and less elevated mountains, mostly formed of stratified limestones on the other.

Shortly afterward, Pini decided to try to further interweave the exact sciences and the naturalistic disciplines by applying his mathematical knowledge to the problem of reducing the physical and natural elements (mountains, lakes, valleys, plains, water courses etc.) to abstract geometric figures. The results of this work were the theories outlined in the first part of his essay on St. Gotthard mountain[18], where he presented a geometric-descriptive illustration of the great physical phenomena of the Earth[19] with the aim of establishing "certain principles precisely" and thus free "the mineralogists from the spirit of systems" and the danger of making their observations "without the aid of the sciences required for that aim"[20]. A further step in this direction was taken two years later, while preparing the Italian translation of Nathanael Gottfried Leske's manual *Anfangsgründe der Naturgeschichte* (Leipzig, Crusius 1779). In his long introduction to the work, he outlined the mathematics that he had applied up to that time to the mineral world as well as to living organisms[21].

FIGURE 2. Capo Palinuro and its surroundings. Carta generale dellÍtalia divisa ne'suoi stati e province (Roma: Calcografia Camerale, 1793) n.n. plate.

Thanks to his writings, observations and theoretical reflections, Pini had achieved in the early eighties a considerable reputation not only among the scientists of the Italian Peninsula but also among those from beyond the Alps. He was also esteemed for his assiduous work at the Museum and for his position as professor for Natural History at the college of Sant'Alessandro. In addition, he was known for his efforts in the exchange of minerals and rocks, started in 1779[22], with the Museum of the University of Pavia directed by Lazzaro Spallanzani, professor of Natural History at that University[23].

In 1784, he was invited to join the Società Italiana delle Scienze, established in 1782 by the Veronese mathematician Anton Maria Lorgna[24]. It is likely that it was Spallanzani[25] who suggested Pini's candidature to Lorgna, probably drived by the desire to stave off the eventual nomination of the botanist Giovanni Antonio Scopoli[26]. It is also likely that Spallanzani's proposal was accompanied by the tacit assent of the physicist Alessandro Volta, also a professor at Pavia, as well as the technologist Marsilio Landriani. Both Volta and Landriani had had important scientific relations with Pini[27] and had been constantly consulted by Lorgna after their involvement regarding the foundation of the Society in 1781[28].

The Milanese Barnabite was also indebted to Spallanzani for encouraging him, between 1788 and 1789, to write an essay for the *Memorie* of that Society on a geological topic[29]. The relation-

ship between the two scientists. Pini and Spallanzani, went through a particularly tranquil phase at that time. This was due, in part, to Pini's support of his colleague after the embarrassing incident provoked by accusations by the custodian Serafino Volta that he had removed naturalistic material from the Museum of the University of Pavia[30].

The problem that the Milanese Barnabite decided to have him address as his scientific contribution to the periodical of the Società italiana delle Scienze focused on reconstructing the origin and history of the Earth. Pini now wanted to attempt to proceed not only along the lines of mathematical reasoning and naturalistic observations but also by reflecting on the Holy Scriptures. The latter he adopted for the first time and in an explicit way[31] as an interpretative tool for his scientific investigations. He was probably encouraged in this direction, at least in part, also by his willingness to declare that he was in agreement with the metaphysical-theological principles outlined by his powerful co-brother Cardinal Giacinto Sigismondo Gerdil, in two anti-Buffonian writings published in 1775 and 1784[32]. This was a demanding work for Pini, full of difficulties, pitfalls, and obstacles[33], that he carried out with firm determination and, eventually, published in two separate parts[34].

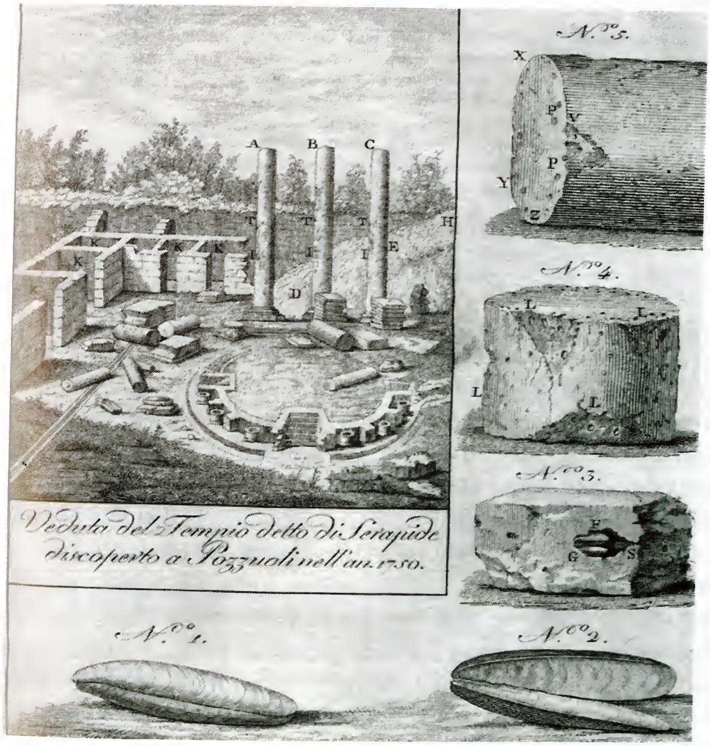
In order to commence his argument, he first found himself in the predicament of having to acknowledge that "the stratification", which proved so useful, as mentioned above, in the application of mathematics for determining the times of formation of the different rocks, "[could] no longer be considered as a key to the theory of the Earth"[35]. Subsequent to "the observations of many", it emerged that, on the one hand, strata were present "also in many materials", such as lavas and tuffs, "which certainly did not originate in water "[36], and, on the other hand, that the study of fossil animals could have constituted a valid starting point for the reconstruction of the history of the Earth. The latter was a discovery that encouraged Pini to approach this new and promising sector of research and to identify, as a useful tool for achieving his scientific-religious aim, "the shells which are contained in the strata "[37] and, more particularly, "the position which some species of pholades (*Pholas dactilus*) and rock-eating mussels (*Mytilus lithophagus*) have in the mountains[38], which is very similar to that which they have in life".

This "position", consistent with the ability to "perforate either the earth or also the stones and to form an alveolus where to perpetually form its niche" was used by the neptunists as evidence to support the idea that, in the past, the sea had "remained permanently on the present continents as high as the highest peaks of the mountains "[39]. This was a conclusion that, in Pini's opinion, was not sufficiently demonstrated and that accordingly required a prompt and detailed revision. Thus, he decided to begin questioning not only the hypothesis, shared by himself, that the marine waters had at one time covered the entire planet, but also the duration of time during which "the sea [remained] at that elevation where now are found those fossils" and to which period could "that presence be referred"[40].

However, before answering the question thus formulated, one had to address another question first: what was the condition of the planet before its peaks had been reached by the sea? Applying once again his mathematical knowledge to the naturalistic disciplines, the Milanese Barnabite hypothesized a first, rapid "revolution", due to the force of rotation, which he introduced as the initial impulse for the process of formation of the terrestrial globe[41]. Such a force, "animated by greater velocity than that required to rotate a fluid body"[42], had altered the original mass composed of water and various earthy substances into a "globe separated into seas and dry land with a shape compressed at the poles and elevated at the equator", which soon was populated by animal and vegetable organisms, not excluding our "most remote ancestors"[43].

Having clarified this problem he turned to the double question of the duration and the period of the rising of the sea. In order to resolve the question he introduced into the scenario a second "tran-

FIGURE 3. Pozzuoli. William Hamilton, *Campi phlegraei, ou observations sur les volcans des Deux Siciles* (Paris: Lamy, an VII), planche XXVI.



FIGUIRE 4. Serapide's Temple. Ermenegildo Pini, "Viaggio geologico per diverse parti meridionali dell'Ítalia," *Memorie di Matematica e di Fisica della Società Italiana delle Scienze IX* (1802): plate VI.

sitory and extraordinary revolution"[44], or rather "Universal Deluge" which, just as the Holy Scriptures had stated, had raised the waters of the planet with violence, taking all the living beings by surprise with its fury.

The link between science and religion thus started to take form and in addition to being put forward as a basis for opposing the neptunist theory which, with its view of a long and tranquil presence of the waters on the planet, was not able to account for a series of phenomena which could instead be better explained, in the opinion of the Milanese Barnabite, by the Deluge of brief duration described in the Holy Scriptures. In particular, he invoked in favour of the "transitory and extraordinary revolution" the findings of the remains of "exotic animals originally from distant and varied places", examples of which were the large land animals of Siberia and the fishes from Monte Bolca, in the Veneto[45], whose presence could not be attributed to a long presence of the sea, but rather to "transport by rapid and impetuous currents "[46].

The Deluge, as introduced by Pini, took place at four different times: an initial period characterized by heavy rains, with the consequent formation of rapid flows and raging streams; a second disruption due to the eruption of water from volcanoes and marine earthquakes, accompanied by strong winds which had brought the water found in the underground caves to the surface, with subsequent abrupt and swirling uplift of the waters; a third phase marked by the slower and more tranquil rise to higher elevations of the waters and of the organisms contained therein (this phase had a duration of not more than the forty days of the Holy Scriptures); finally, the last period, rapid and impetuous in which the waters retreated with violent fury into the underground caves from which they had emerged during the second disruption[47].

Having arrived at this point in his treatise, the Milanese Barnabite could return to the initial problem — that of the lithodomous, or boring bivalves, *Pholas dactilus* and *Mytilus lithophagus*, which, as has been observed, led the neptunists to conclude in favour of the extended presence of the marine waters at elevated altitudes. In continuation of this line of reasoning, Pini asked himself why it was that "in many places, and mostly the highest"[48] there remained only a few traces of these organisms or they were completely lacking. It seemed to him that this fundamental question, which was inexplicable for the neptunists, could be resolved by the idea of a rapid rise of the sea during which impetuous currents were formed. The latter raised and then dragged down the borers and finally deposited them only in places where they had passed.

Pini maintained that with this latter observation he had put forward sufficient arguments in favour of the Deluge and decided thus to conclude his reflections with the following words: "those who consider that the rock-eating mussels live as great copies in many seas, and most of all along the coasts of the Mediterreanan, easily may concede that, if the sea was permanent at a height either the same or greater than that in which those worms became fossils, these should be found in the present mountains in huge quantities and in many places; and as this phenomenon is rarely found it is quite natural that the fossils are a portion of those shells which, having been transported lived during the extraordinary flood"[49].

However, as soon as he presented this interpretation he found himself having to recognise its fragility. The scarcity of argumentation on which he had developed his theory did not in fact allow him to establish with certainty, and for the entire planet, that above a certain altitude the traces left by the borers were either scarce or completely absent. Therefore, the neptunists could still continue to place in doubt the centrality of the Deluge, or even deny it, thus causing the ruinous collapse of all the conceptual views which he had constructed with such patience.

The question, therefore, required more in-depth consideration with timely and focused observations. The latter became more urgent following the publication, of which the Milanese Barnabite only became aware of while bringing his work to a close[50], of an essay on Calabria by the neapoli-

tan scholar Angelo Fasano[51]. In this work, the author proposed the following: "From the promontory of Palinuro as far as Fuscaldi in upper Calabria all the calcareous cliffs of that coast, which descend to the shore, are at a lower level than the shore or at the same level, all bored by *Mytilus lithophagus* and for making our discourse easier let us say pholades [...] And it is best to observe and consider that the walls of those cliffs, where those animals exist are bored from top to bottom successively, that is to say, without intervening intervals and that those borings observing from bottom to top, in proportion as they ascend, may be recognised due to the erosion of the stone in the open air. [...] From all this is retained that the waters must have remained for a long time in these places; and must have abandoned them not for sudden lowering or retreats but very slowly and throughout centuries"[52]. These ideas, which were rather awkward in Pini's opinion; their precision needed immediate verification in order to establish their scientific significance. Thus, Pini decided to explore the Italian Peninsula in search of clues, that is for traces and signs capable of disproving the neptunist theory and, therefore, reinforcing the idea of the Deluge.

Alongside this inevitable objective Pini placed another purpose of rather less importance, but neccessary in order to justify the usefulness of the expedition to the government authorities of Austrian Lombardy. He intended to collect naturalistic material for the Museum of Sant'Alessandro and for the University of Pavia[53], both already well known to the general public and scholars of Europe for the abundance and variety of their collections.

Regarding the expedition, Pini left behind a wonderful report, in places brillantly penetrating, and rich in stimulus and suggestion.[54] The report, written in the form of a letter to the plenipotentiary Johann Joseph Wilczeck[55], due to the courtesy of whom he had obtained from the government the neccessary financial aid[56], starts with the explicit confirmation of his intention to combine observations of natural objects with reflections on the Holy Scriptures[57]. He then continues with the description of phenomena indicative, in his opinion, of the authenticity of the Deluge. In particular, he describes the internal structure of the hill of Impruneta, south of Florence, and the rocks around Fiesole[58]; the presence of fossil marine shells on Monte Mario, just outside Roma[59]; the birth of Monte Nuovo in the Bay of Pozzuoli; the consistency taken on by the earth and the sand of that elevation over the course of its two and a half centuries of life[60]; and, lastly, concludes with an account of the exploration of the coast of Campania[61].

Pini arrived in Naples on 20 August[62] and tried in various ways "to make the suitable arrangements for travel along the maritime coast as far as Calabria"[63], even though he was aware of the dangers involved in undertaking travel "in the hot season due to the pestilent air from the beaches"[64]. By the end of the August, the expedition was ready to leave Naples to go to Capo Palinuro where he could investigate the credibility of Fasano's claims[65]. As soon as he arrived at Capo Palinuro, he disembarked from the ship on which he had traveled and boarded a small local boat "in order to be able to more easily approach each site in his surroundings". He then examined the rock outcrops in great detail, finding that they "were riddled by frequent borings in many places but that their internal surface was neither smooth nor of the appropriate shape for date mussels" and that "their size [of the borings] was very often much larger than those usually made by those worms". Besides, there was no trace of a shell, and, above all, the borings "were not found above a height of only a few tens of feet above the sea level, at a height reached by the breakers of a not very high sea, the latter being very effective with the passage of time at excavating deep and copious borings in the calcareous rocks "[66]. Therefore, these "could not be used to prove that the sea had remained for a long time as high as the highest peaks of the mountains".

The survey took two days at the end of which the Milanese Barnabite — even if he were not able to complete the entire travel from Capo Palinuro to Fuscaldi due to symptoms of a "raging fever"[67]

because of "sunstroke" suffered during the survey itself[68] — decided that Fasano's conclusions were devoid of scientific value. Nevertheless he underlined, with diplomatic courtesy, as he was now in much more lighthearted spirits as his worries regarding Fasano's claims were at an end, that the expedition of the Neapolitan scholar having been carried out with the purpose of visiting the places affected by the earthquake of 1783, the circumstances in which he found himself did not allow him "to lend to his observations all the precision required by mineralogists"[69].

However, the purpose of the travel by the Milanese Barnabite had as yet not been completely realized. Although in itself reassurring, the fact that he did not find traces of borers on the cliffs around Capo Palinuro did not constitute sufficient proof for confirming in a definite way their absence in other places but could be put forward in support of continuing observations and by carrying out new comparisons, verifications and inspections.

In this regard, Pini managed to give a new advantageous perspective, and as soon as he recovered from both the initial and then even more violent fever attacks, he carried out a detailed examination of the ruins of the Temple of Serapis, in the Bay of Pozzuoli. His attention had already been drawn to the Temple during a brief trip he made there prior to visiting Capo Palinuro. It left him with an impression "of a phenomenon fit to make the heads of the most expert geologists spin"[70].

The building, which today we know functioned as a *macellum*, or food market, and later served as a temple dedicated to Jupiter Serapis, had been constructed shortly after the reign of the Emperor Augustus, that is sometime between the end of the 1st and the beginning of the 2nd centuries, and it achieved its definitive lay-out in the 3rd century. It was formed of a quadriporticus surrounded by *tabernae*, or shops, and was supported by thirty-four columns, with granite shafts, that enclosed a courtyard with splendid marble paving. On the side opposite to the entrance was an apse, or exedra, a place of worship. The latter was preceded by a *pròpylon*, a vestibule, the front of which was formed of four marble columns, three of which — unique in the complex — were still standing. At the center of the courtyard was the *thòlos*, a construction with a circular vault with sixteen columns. The ruins, which came to light in 1753 following archeological excavations started three years earlier, immediately became the focus of research not only by archeologists and scholars of antiquity but also by naturalists. The marble columns were, in fact, eroded by borers, which indicated that the sealevel had risen high enough to cover them and then it retreated, an enigma difficult to resolve for geologists who had been invited to explain the dynamics of the double variation in height. Nowadays we know that the cause of this is the phenomenon of bradyseism or rather the slow occurrence of vertical displacements of the Earth's crust that determine the alternation of uplift and subsidence of the land with respect to sealevel, with transgressions and regressions of the sea and consequential and often subtle alteration of the position of the coastline[71].

Pini made his second visit to the temple while he was still weak from his illness and "with a leg which from the remains of the fever was bored in such a way that it resembled one of those columns"[72]. On this occasion, Pini traveled with Scipione Breislak, professor of Chemistry and Mineralogy in the Royal Artillery Corps of Naples and director of the solfatara of Pozzuoli[73], and with William Thomson, an English physician and mineralist who for many years lived in Naples. During the visit, the Milanese Barnabite once again found himself "in such a whirl that [he despaired] of being able to say something plausible"[74]. Yet, nevertheless, he was determined to attempt a response.

The first step was the examination of the most authoritative hypotheses expressed until then. He began with that by Ferber[75], who had tried to explain the phenomenon, claiming that the sea, having risen after the construction of the building, remained thus for hundreds of years, and finally subsided. Pini rejected this explaination, citing as a reason the fact that such a rise, which due to the laws of equilibrium of fluids should have been extended to all of the Mediterranean, flooding

the coasts and causing calamities and disasters — of which there was no evidence[76].

The Milanese Barnabite then went on to evaluate the second supposition, the author of which, never explicitedly named by him, can nevertheless be recognised as the English diplomat living in Naples, William Hamilton, a scholar of volcanic phenomenon and collector of archeological findings[77]. Hamilton had imagined a lowering and subsequent uplift of the ground, both due to earthquakes. This supposition, which the Milanese Barnabite called with an ironic expression, the "dance of the temple", was rejected by him on the basis of the fact that the typical irregularity of the movements of earthquakes would have broken up the floor of the building, especially during the phase when the ground reemerged, thus causing all the columns to fall[78].

Finally, Pini also rejected the last of the attempts at explaining the phenomenon known to him, that of his friend Lazzaro Spallanzani[79] who, leaving aside the movements of sea and ground, had imagined that the columns had been eroded by borers prior to being used for the construction of the temple. Pini was outraged at the idea that one could think that defective materials had been used in the construction of a monument of such majesty. He observed that the presence of borings of marine borers in broken areas of the ruined columns indicated that the columns had been attacked after construction and eventual collapse of the building. The explaination, therefore, was without foundation[80].

Having rejected the most widespread theories, Pini went on to develop his own theory. He based it on his conviction that the columns had been bored by the bivalves after the temple had fallen[81]. He, thus, continued his line of reasoning by hypothesising that the cause of the ruin had been a volcanic eruption, most probably that of Solfatara (1198), which had covered the building with "ashes and other volcanic materials, which later were united together". This acted to create a sort of raised levee around the temple, within which a hollow was formed. Subsequently, sea waters, suspended by a tidal wave or precipitated following a second volcanic eruption, probably that of Monte Nuovo (1538), entered that hollow dragging with it "lithophagus mussels, or their seeds or germs"[82], and formed a small lake[83].

Having achieved this perspective, the Milanese Barnabite concentrated his efforts on surmounting the final difficulty to "explain how the sea waters brought into the indicated small lake were [conserved] for so long, the time [required] for the marine worms to grow and to do the work which may be observed on the ruins of the temple"[84]. His response was that "for a certain time in that small lake some source of fresh water [had flowed] which [had protected] the loss of water which the lake should have [suffered], especially due to evaporation [...] and then [it dried out and diminished], in such a way as to no longer be sufficient to feed the lake " which, in its turn disappeared[85].

The reconstruction done in this way, that relied on the theory that only a few centuries were sufficient for the bivalves to bore into the columns of the temple, thus allowed Pini to reinforce his convictions regarding the authenticity of the Deluge. The phenomenon of the small lake, which had covered the ruins of the building, was the new element introduced by him in support of his view of the history of the Earth. In his final geological work, he maintains that, "after the extrordinary and general flooding, [there remained] at different elevations a few saline lakes in which [there multiplied] some species of marine worms, and that after a certain time [were dried]"[86].

The temporary presence of the lakes, similar to that formed around the Temple of Serapis and situated at elevated altitudes, together with the impetus of the currents formed due to the rapid rise and lowering of the sea waters, provided Pini adequate explanation for why the remains of the marine borers were found in some areas of the Earth and not uniformly dispersed everywhere

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Notes

1 For a general biography on Pini see Cesare Rovida, *Elogio di Ermenegildo Pini* (Milano: Truffi, 1832).

2 Corresponding to the southern part of the present-day Campania.

3 Ermenegildo Pini, *Dell'architettura Dialogi* (Milano: Marelli, 1770).

4 Carlo Mariani, "Il padre Ermenegildo Pini e il primo pantheon lombardo: la parrocchiale di San Giuseppe a Seregno", *Barnabiti Studi* 13 (1996), pp. 133–238.

5 Agnese Visconti, "Alcuni aspetti svelati dell'attività del naturalista milanese Ermenegildo Pini", in *Figure dell'invisibilità Le scienze della vita nell'Italia di Antico Regime Atti delle giornate di studio Milano-Ginevra (novembre 2002-giugno 2003),* Maria Teresa Monti and Marc J. Ratcliff, editors (Firenze: Olschki, 2004), p. 156.

6 Visconti, "Alcuni aspetti", pp. 151–155.

7 Agnese Visconti, "I viaggi compiuti da Ermenegildo Pini tra il 1777 e il 1782 Una breve stagione geografica", *Schede umanistiche* 1 (2004), pp. 77–108; Laura Panzeri, "L'industria del ferro in Valsassina alla fine del Settecento", *Il Risorgimento* 30/1-2 (giugno 1978), pp. 14–54.

8 The Delegation was confirmed on him by dispatch on the 6th October 1782 (Archivio di Stato di Milano (hereafter ASM), Commercio p.a., 205).

9 On the growth in mining production, and in particular iron production in Austrian Lombardy during the years when Pini was delegate see Armando Frumento, *Imprese lombarde nella storia della siderurgia italiana* (Milano: Allegretti di Campi, 1963) , vol. 2, pp. 300–409; Agnese Visconti, "Assolutismo illuminato e ruolo dei boschi: il caso lombardo nel dibattito tra Vienna e Milano, 1771–1789", *Storia urbana* 20 (luglio-dicembre 1996), pp. 13–34.

10 Regarding the museum and its collections in the years just after its foundation see Hermenegildus Pinus, *Catalogus fossilium quae extant in Musaeo D. Alexandri* [...] *anno MDCCLXXV* (Österreichische Nationalbibliothek, Cod. Ser. Nov. 1909).

11 Hermenegilde Pini, *Memoire sur des nouvelles cristallisations de feldspath et autres singularités renfermées dans les granites des environs de Baveno* (Milan: Marelli, 1779). The choice of the French language was dictated by Pini's intention to also make his studies known to the naturalists beyond the Alps. For a comment approving this choice refer to the *post scriptum* in the letter from Kaunitz to Firmian dated 5th July 1779 (ASM, Studi p.a., 106).

12 Pini, *Cristallisations de feldspath*, pp. 43–44. The reference is to Peter Simon Pallas, *Observations sur la formation des montagnes et les changements arrivés à notre globe* (St. Petersbourg, et Paris: Méquignon, 1777). For a summary of the work in Italian see A. [Carlo Amoretti], "Osservazioni sulle montagne", in *Opuscoli scelti sulle scienze e sulle arti* (Milano: Marelli, 1779), vol. 2, pp. 342–348.

13 Pini, *Cristallisations de feldspath*, pp. 44–45.

14 Pini, *Cristallisations de feldspath*, pp. 45–47. The references are to Johann Friedrich Wilhelm von Charpentier, *Mineralogische Geographie der Chursächsischen Lande* (Leipzig: Crusius, 1778); and to Johann Jakob Ferber, *Lettres sur la Minéralogie et sur divers autres objects de l'Histoire Naturelle de l'Italie écrites à Mr. le Chevalier de Born* (Strasbourg-Paris, 1776).

15 Pini, *Cristallisations de feldspath.*, pp. 47–49. The reference is to Torbern Olof Bergmann, *Physik Beskrifning över Jordklot* (Upsala: Edman, 1766). Pini was familiar with the German translation of this work by Lampert Heinrich Röhl (1769).

16 Ermenegildo Pini, "Della maniera di osservare sui monti la disposizione degli strati con uno stromento

comodissimo a tal fine", in *Opuscoli scelti sulle scienze e sulle arti* (Milano: Marelli, 1780), vol. 3, pp. 183–195.

17 Ermenegildo Pini "Della elevazione dei principali monti", in *Opuscoli scelti sulle scienze e sulle arti* (Milano: Marelli, 1781), vol.4, pp. 3–22.

18 Ermenegildo Pini, *Memoria mineralogica sulla montagna e sui contorni di S. Gottardo* (Milano: Marelli, 1783).

19 Pini, *Montagna di S. Gottardo*, pp. 1–73.

20 Pini, *Montagna di S. Gottardo*, pp. 2–3.

21 Nathanael Gottfried Leske, *Elementi di Storia Naturale* (Milano: Monistero di Sant'Ambrogio Maggiore, 1785), pp. III–CLXVI.

22 Regarding this refer to the letter to Spallanzani by the counsel of the government of Austrian Lombardy Nicola Pecci of 23rd January1779 (ASM, Studi p.a., 445) and that by Spallanzani to the plenipotentiary Carlo Firmian of 27th January in *Edizione nazionale delle opere di Lazzaro Spallanzani (Carteggi),* Pericle Di Pietro, editor, (Modena: Mucchi, 1985), vol. 4, p. 302.

23 On the common collection-museological objectives of the two scientists see Paolo Mazzarello, *Costantinopoli 1786: la congiura e la beffa. L'intrigo Spallanzani* (Torino: Bollati Boringhieri, 2004), p.187. On the Museum of Pavia refer to *Il Museo di Lazzaro Spallanzani 1771–1799 Una camera delle meraviglie tra Arcadia e Linneo,* Clementina Rovati and Paolo Galeotto, editors, (Cava Manara (Pavia): Greppi, 1999).

24 On the foundation and history of that Society see Giuseppe Penso, *Scienziati italiani e Unità d'Italia Storia dell'Accademia Nazionale dei XL* (Roma: Bardi, 1978).

25 On the role of Spallanzani as confidant of Lorgna see Penso, *Scienziati italiani*, pp. 33, 53, 58.

26 On the difficult relationship between Spallanzani and Scopoli see Mazzarello, *Costantinopoli 1786,* passim.

27 On the relationships between Pini and Volta see Pini, "Della elevazione dei principali monti", p. 22; on those with Landriani see Ermenegildo Pini, *Relazione del viaggio mineralogico fatto nell'anno 1779 in diverse parti della Lombardia Austriaca* (ASM, Commercio p.a., 203), § 13.

28 Penso, *Scienziati italiani,* p.38.

29 As is indicated by the letter from Pini to Lorgna of 3rd September 1789, in the Archivio Storico dell'Accademia dei XL, Correspondence of the early forties with Anton Maria Lorgna, 157, ua. 38 (hereafter ASAXL).

30 Pini was charged by the Hapsburg government to proceed, together with brother Giuseppe Maria Racagni, to the dwelling of Spallanzani in Scandiano in order to check the possible presence of some naturalistic specimens which were missing from the Museum of Pavia. The control was carried out with extreme tact, as is indicated by the report presented by them on 26th January, 1787 to the government of Austrian Lombardy, which allowed the public authority to rapidly bring the regrettable incident to a close (ASM, Autografi, 180).

31 An implicit reference to the Holy Scriptures is present in Pini, *Montagna di S. Gottardo*, pp. 65–66, where the author refers to the Deluge as a tool for the reconstruction of the history of the Earth.

32 As is indicated by Ermenegildo Pini, "Sulle rivoluzioni del globo terrestre provenienti dall'azione delle acque" (part 1), *Memorie di Matematica e Fisica della Società Italiana* 5 (1790), pp. 163–258, where the author after having described Gerdil as "one of the greatest and most sage intellectuals of our century", recalls (p. 164, note a) his two writings "Saggio d'instruzione De' Sistemi di Storia naturale relativi all'antichità del mondo, inserito nel Saggio di instruzione Teologica stampato per la prima volta in Roma nell'anno 1775", in *Opere edite ed inedite del cardinale Giacinto Sigismondo Gerdil* (Roma, 1808), vol. 10, pp. 306–318 and "Observations sur les Epoques de la Nature", in *Opere Gerdil,* pp. 368–390. Regarding Gerdil and his theological-philosophical thought see *Barnabiti studi* 18 (2001), pp. 7–372.

33 See the letter from Pini to Lorgna of 3rd September 1789, in ASAXL.

34 Pini, "Sulle rivoluzioni", and Ermenegildo Pini, "Memoria geologica sulle rivoluzioni del globo terrestre provenienti dall'azione delle acque"*Memorie di Matematica e Fisica della Società Italiana* 6 (1792), pp. 389–500. For a criticism of the two writings see Nicoletta Morello, "La Geologia nel Settecento italiano. Note

sul diluvialismo", *Rendiconti Accademia Nazionale delle Scienze detta dei XL. Memorie di Matematica e di Scienze Fisiche e Naturali* 100/6 (1982), pp. 103–114.

35 Pini, "Sulle rivoluzioni", p. 222.

36 Pini, "Sulle rivoluzioni", p. 232.

37 Pini, "Sulle rivoluzioni", pp. 232–233.

38 Pini, "Sulle rivoluzioni", p. 242.

39 Pini, "Sulle rivoluzioni", p. 244.

40 Pini, "Sulle rivoluzioni", p. 246.

41 Pini himself commented after that supposition affirming that "the main novelty in [his] theory [consisted in] assuming that the rotation was one of the reasons for the primary configuration of the globe which was presumed to be originally fluid " (Ermenegildo Pini, *Sui sistemi geologici Riflessioni analitiche* (Milano: Pirotta, 1811), pp. VII–VIII).

42 Pini, "Memoria geologica", p. 390.

43 Pini, "Memoria geologica", p. 390. The subject of the population of the planet by human beings after the first revolution Pini treats in greater detail in his following geological work, "Sugli animali fossili Memoria geologica", *Memorie di Matematica e di Fisica della Società Italiana delle Scienze* 12/2 (1805), pp. 270–329.

44 Pini, "Memoria geologica", pp. 390–391.

45 Pini, "Memoria geologica", pp. 454 e 460–466.

46 Pini, "Memoria geologica", p. 452.

47 Pini, "Memoria geologica", pp. 408–423.

48 Pini, "Memoria geologica", p. 423.

49 Pini, "Memoria geologica", pp. 470–473.

50 As shown by Pini, "Memoria geologica", pp. 470–471. Also refer to the two letters by Pini to Lorgna of 5th June and 25th November 1792 (ASAXL).

51 A. Fasano, "Saggio geografico-fisico sulla Calabria Ulteriore", *Atti della Reale Accademia delle Scienze e Belle Lettere di Napoli* (1788), pp. 251–311.

52 Fasano, "Saggio geografico-fisico", pp. 258–259.

53 In relation to this see the letter by Pini to V.E. [Wilczeck] of 27th April, 1792, where the Milanese Barnabite expresses his intention of "making collections of precious natural products in order to increase the museums of Austrian Lombardy"; and that to the government of the 21st December 1792 where Pini gives an account of the naturalistic objects collected and acquired during the travel, underlining that he had obtained "several rarities, mainly mineralogical, some of which he knew were lacking in the distinguished collection constituting the the Museum of Pavia which was considered as the best of Italy". Both letters are in ASM, Autografi, 180.

54 Ermenegildo Pini, "Viaggio geologico per diverse parti meridionali dell'Italia", *Memorie di Matematica e di Fisica della Società Italiana*" 9 (1802), pp. 118–120.

55 Even if the plenipotentiary is never explicitly named, the reference to him is apparent on pp. 118–119 and 204.

56 The decision by the government to advance Pini £1500 of his salary as Delegate of Mines is of the 21st May 1792 (ASM, Commercio p.a., 205).

57 Pini, "Parti meridionali dell'Italia", pp. 121–122 e 128.

58 Pini, "Parti meridionali dell'Italia", pp. 146–147.

59 Pini, "Parti merdionali dell'Italia", pp. 165–166.

60 Pini, "Parti meridionali dell'Italia", pp. 176–179.

61 Pini, "Parti meridionali dell'Italia", pp. 184–190.

62 Refer to the letter of the 21st August 1792 from Pini to V.E. [Wilczeck] (ASM, Autografi, 180).

63 Pini, "Parti meridionali dell'Italia", p.166.

64 Pini, "Parti meridionali dell'Italia", p.166.

65 Pini, "Parti meridionali dell'Italia", p. 190.
66 Pini, "Parti meridionali dell'Italia", p. 187.
67 Pini, "Parti meridionali dell'Italia", p. 185.
68 Pini, "Parti meridionali dell'Italia", p. 185.
69 Pini, "Parti meridionali dell'Italia", p. 190.
70 Pini, "Parti meridionali dell'Italia", pp. 179–181.
71 For an exhustive and fascinating synthesis of the studies on that temple see Luca Ciancio, *Teatro del mutamento Immagini del 'Tempio di Serapide' a Pozzuoli (1750–1900)* (Rovereto: Nicolodi, 2005).
72 Pini, "Parti meridionali dell'Italia", p. 205.
73 Regarding the visit to the temple Breislak wrote a report in Scipione Breislak, *Topografia fisica della Campania* (Firenze: Bazzini, 1798), pp. 300–304; and in Scipion Breislak, *Voyages physiques et lythologiques dans la Campanie* (Paris: Dentu, an IX–1801), pp. 167–170, where, even if agreeing with the confutations by Pini of Ferber, Hamilton and Spallanzani, he gives no judgement on the phenomenon.
74 Pini, "Parti meridionali dell'Italia", p. 205.
75 Ferber, *Lettres sur la mineralogie,* pp. 265–266.
76 Pini, "Parti meridionali dell'Italia", p. 208.
77 Ciancio, *Teatro del mutamento*, pp. 30–33.
78 Pini, "Parti meridionali dell'Italia", pp. 213–214.
79 Lazzaro Spallanzani, *Viaggio alle Due Sicilie e in alcune parti dell'Appennino* (Pavia: Comini, 1792), vol.1, pp. 77–82.
80 Pini, "Parti meridionali dell'Italia", pp. 214–215.
81 Pini, "Parti meridionali dell'Italia", pp. 215–216.
82 Pini, "Parti meridionali dell'Italia", p. 221.
83 Pini, "Parti meridionali dell'Italia", p. 222.
84 Pini, "Parti meridionali dell'Italia", p. 223.
85 Pini, "Parti meridionali dell'Italia", p. 224.
86 Pini, *Sistemi geologici,* p.74.

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Earthworm Diversity and Land Evolution in Three Mediterranean Districts

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The collection and description of terrestrial oligochaetes in the Mediterranean began during Napoleon's campaign to Egypt. Many other collections were made during the 1800s, so that at the turn of the century it was already possible to draw a faunistic picture and make biogeographic considerations on this animal group. However, more methodical and focused investigations were needed to identify boundaries and gaps in the distribution patterns. Thus, starting in 1980, a number of expeditions to the countries bordering the Mediterranean took place in the framework of a joint faunistic program by the Universities of Padua, Catania, Siena, Rome "La Sapienza", and Rome "Tor Vergata". In this paper we report on the Oligochaeta Megadrili and Enchytraeidae collected by the authors and coworkers in Maghreb, Anatolia and the Sardo-Corsican system. We then discuss the biogeographical hypotheses that emerge from the elaboration of the gathered material.

Concerning the fauna of Maghreb, little was known prior to our collections. The fauna of this vast and ecologically varied territory has turned out to be rather poor and largely derived from the fauna inhabiting the Betico-Rifan region plus elements of Balkan origin.

Knowledge of the Anatolian megadrile fauna was much better but still limited. Our extensive surveys have revealed that this large peninsula harbours a rich autochthonous fauna comprised of the subfamily Spermophorodrilinae, with ten species exclusive to Turkey, and fourteen endemic species of *Dendrobaena*, some of which may have originated by adaptive radiation. During the Pleistocene, other species of megadriles arrived in Anatolia from the Balkan Peninsula, but they remained confined to the northern coastal zone.

The Sardo-Corsican fauna was already well documented, but its complexity has been appreciated only after careful research in Gallura, the northeastern corner of Sardinia, where the endemicity rate is high and the faunistic connections with Corsica and the Tuscan archipelago are evident. But this is only a part of the story. The autochthonous fauna of the Sardo-Corsican system originates with certainty from Catalonia and, to a lesser extent, from Provence. This peculiarity fits the palaeogeographical reconstructions proposed by geologists, starting with Alvarez and coworkers: the Sardo-Corsican system, formerly part of the European foreland and contiguous to the Pyrenees, became an independent microplate in the late Oligocene, which drifted until it reached the present position, carrying on itself a sample of Palaeogene fauna. At some later stage, a land bridge connected Provence with Corsica and, thus, indirectly with Sardinia. Other massive faunal exchanges must have occurred during the Messinian salinity crisis and the sea level regression caused by the Pleistocene Ice Age, when Corsica and Sardinia were connected to other districts of the central Mediterraean.

1. Exploration and Descriptive Work

1.1. Historical Collections

The first collection of earthworms in a Mediterranean country was carried out in Egypt by M. Jules César Savigny (1777–1851), a young French naturalist accompanying Napoleon's Egyptian campaign of 1798–1802. Subsequent early collections were made mainly by gentlemen fond of natural history and exploration, who travelled on behalf of scientific museums: Henri Gadeau de Kerville (1858–1940) collected specimens in the Near East and in Maghreb; Dr. Enrico Festa (1868–1939) collected in Anatolia and Sardinia (as well as in South America and the Far East); Fritz Haas (1886–1969) collected in Spain, France and the Pyrenees; Marquis Saverio Patrizi (1902–1957) explored the caves of Sardinia and Africa; and Dr. Knut Lindberg (1892–1962) from Lund collected in Greece, Anatolia, and Afghanistan, also mainly in caves. Naturalists and curators of Vienna Hofmuseum, such as Emil von Marenzeller (1845–1918), Ludwig Ganglbauer (1856–1912), and Arnold Penther (1865–1931), collected interesting material in Veneto, Dalmatia, and Turkey.

Many zoologists, specialists in Oligochaeta, collected material in the surroundings of their own institutions, or entrusted correspondents or friends with the task of digging out specimens during their field trips. Wilhelm Michaelsen (1860–1937), director of the Zoological Institute and Museum in Hamburg, obtained rich oligochaete material from scientific expeditions from all around the world and also through the efforts of navy officers calling at that important Hanseatic port. Kurt Kosswig (1903–1982), who succeeded Michaelsen in the chair and as director of the Hamburg Museum, had himself assembled an earthworm collection while in exile in Turkey.

However, around the middle of the 20th century, the inadequacy of the collecting made in the Mediterranean became evident, especially in the light of the synopses compiled on the earthworm faunas of northern and central European countries (Cernosvitov 1935; Cernosvitov and Evans 1947; Pop 1948; Julin 1949; Graff 1953; Stöp-Bowitz 1969; Perel 1979). Particularly informative and influential was the monograph by Bouché (1972) on the *Lombriciens de France*, a work that revealed an unsuspected species richness in the Pyrenean departments and contained a useful systematic revision of the western European megadriles.

1.2. Recent Collections

Owing to their physiological aptitudes, ecological constraints, and limited dispersal capability (individuals cannot move actively over long distances), earthworm populations tend to remain in the same places during very long periods of time, following the destiny of their habitat and geographic area. Moreover, because genetic evolutionary changes occur very slowly in earthworms, events of allopatric speciation must require a time scale measured by millions of years (see Cobolli et al. 1992; Omodeo 2000), i.e., the same time scale of geological events. Thus the history of an earthworm species can be correlated with the geological transformation of its geographic range. Such a correlation was noticed and exploited in biogeographical studies since long ago: for instance, Michaelsen (1902, 1903) interpreted the absence or presence of endemic lumbricid species at various latitudes with the extension of the ice sheets covering part of Europe and Asia during the last glaciation. Cernosvitov (1932a, b, 1935) followed the same trail to explain the distribution patterns of Czech lumbricids. Michaelsen (1922) and Cernosvitov (1936) were also the first to adopt Wegener's theory of continental drift to reconstruct the phylogeny and explain some geographical patterns of oligochaetes, with hypotheses that seemed heretical at the time (see Benham 1922). In the longer run, Omodeo (1952) linked the present distribution of some southern

European species to the Miocene palaeogeography of the Aegean region, and adopted Michaelsen's views in interpreting the amphiatlantic distribution of some megadrile genera (Omodeo 1954, 1963, 2000).

That considered, and stimulated by the available faunistic evidence and the novelties emerging from the geological surveying of the Mediterranean basin (Alvarez et al. 1974), in the late 1970s a research program was launched by the senior author (P.O.) in Padua to methodically prospect the terrestrial oligochaete fauna of the Mediterranean countries and gain some insight into its origins and evolution.

1.3. The Program

The program, coordinated with similar research programs by other Universities focusing on different animal groups, was approved and soberly financed by the Italian National Research Council and the Ministry for the University and Scientific Research. The sampling of terrestrial oligochaetes started in May 1980 in Sardinia and, within the span of twenty years, covered territories from the Iberian Peninsula and Morocco to Anatolia and the Levant, but it was in fact in the Sardo-Corsican system that the efforts were concentrated, as these islands showed many interesting peculiarities. The visits to Sardinia and adjacent lesser islands implied some logistic difficulties, which were overcome thanks to the aid from colleagues working at Sardinian Universities and the backup to the senior author by the CNR oceanographic vessel *Minerva*. In the period 1980–1999, the archipelago was visited 12 times and about 5000 specimens were collected.

In all five expeditions to Maghreb, the major organizing work was carried out by the Zoology Department of Catania University and, to a lesser extent, by the Biology Departments of Padua and Siena Universities. The teams always travelled by off-road vehicles equipped with roof top tents, which made it possible to venture into remote or uninhabited regions such as the semidesert basin of Hodna and the Djurdjura Massif in Algeria. A total of 135 collecting sites were visited and several groups of arthropods and other invertebrates were collected, including 4900 megadrile specimens. The latter were preserved in ethanol or in liquid nitrogen or kept alive according to the planned studies. During the 1989 expedition, a survey of the terrestrial Enchytraeidae of Tunisia and Algeria was also performed. Additional 1500 oligochaete specimens were sampled and studied by Mounia Baha, a Ph.D. student of the Ecole Normale Supérieure d'Algiers; this material included three new records for Algeria and one species new to science.

The two journeys to Turkey were organized in 1987 and 1990 within the frame "Zoological Researches in the Near East by La Sapienza and Tor Vergata Universities of Rome" and represented the first extensive surveys of the Turkish drilofauna. Much information was available on the megadriles of this vast country, but no methodical study had been carried out which could reveal a general picture and the main geographic patterns of the fauna. Travelling by utility cars and minibus on a good road system and benefiting from the friendly hospitality of the Turkish people, we visited 62 localities (involving 26 vilayets), thus gathering more than 3000 oligochaete specimens. Additional material was obtained from colleagues and friends who visited the country to investigate other animal groups of interest.

1.4. Results of the Research Journeys to Maghreb

The Maghreb (Tunisia, Algeria and Morocco) collections yielded a total of 31 megadrile species, 18 of which were new for the territory and four new to science (Omodeo et al. 2003). The megadrile fauna of this vast and ecologically various territory is scanty in comparison with those of Spain and Italy (~ 100 species in either country). [With one exception, *Helodrilus rifensis*, all

the new taxa described from Algeria and Morocco by Qiu and Bouché (1998a, b) must be considered *species inquirendae*, because their descriptions differ in trifling details — or do not differ at all — from one another or from long known species]. Moreover, its composition changes from West to East: the Moroccan species are almost the same as those inhabiting the south of the Iberian peninsula and the Canary Islands, with the interesting exception of *Allolobophora borellii* (Cognetti, 1904) which is widespread in Morocco and western Algeria and is recorded in Spain only from the Pyrenees. The Algerian fauna lacks two species living in Morocco (*Lumbricus friendi* Cognetti, 1904 and *Helodrilus rifensis* Qiu and Bouché, 1998) but counts four endemic species, two of which surprisingly belong to an Alpine-Balkan genus, *Octodrilus kabylianus* Omodeo and Martinucci, 1987 and *O. maghrebinus* Omodeo and Martinucci, 1987; the third species, *Eisenia xylophila* Omodeo and Martinucci, 1987, also has eastern affinities, while the fourth belongs to the Pyrenean genus *Prosellodrilus* Bouché, 1972 (*P. doumandjii* Baha and Berra, 2001). On the Edough promontory and in adjacent areas lives a population of *Hormogaster redii* Rosa, 1887, possibly arrived there from Tunisia (it is found abundantly on Mt. Zaghouan) or directly from Sardinia (see below). In Tunisia, no other endemics than *O. maghrebinus* and *E. xylophila* are reported, and the *Allolobophora molleri* (Rosa, 1889) complex (= *Heraclescolex* Qiu and Bouché, 1998), so common in the mud of ouadies in Algeria and Morocco, disappears; it is replaced by a vicariant species still undescribed belonging to the *Nicodrilus* Bouché, 1972 group. The most important absentees in Maghreb are the archaic megadrile genera which form such a large part of Pyrenean and Iberian fauna: *Orodrilus* Bouché, 1972, *Scherotheca* Bouché, 1972, *Postandrilus* Qiu and Bouché, 1998 and *Ethnodrilus* Bouché, 1972. *Prosellodrilus* is represented by only one or two localized populations (*P. doumandjii* near Algiers, *P. festai* (Rosa, 1892) near Tunis) and the family Hormogastridae is represented only by its most widespread species. The time of the arrival of *H. redii* in Tunisia has been dated by molecular clock methods (Cobolli et al. 1992) to the Messinian salinity crisis (5.33–5.96 Mya), when possibly also *Dendrobaena byblica* (Rosa, 1893), *Proctodrilus antipai* (Michaelsen, 1891) and modern type taxa such as *Allolobophoridella eiseni* (Levinsen, 1884) and *Murchieona minuscula* (Rosa, 1906) reached the west of the Mediterranean basin.

From soil samples collected in 1989 in Tunisia and Algeria, 20 species of terrestrial Enchytraeidae were also recognized, 17 of which were new for Maghreb and one new to science (Rota and Healy 1994; Rota 1995). These results, unprecedented for North Africa, were made possible by developing adequate methods and devices for collecting, field extracting and maintaining these delicate animals alive until the return to laboratory (Healy and Rota 1992). However, despite the variety of habitats explored, the species list is short compared with similar sized regions in temperate Europe and is dominated by some widespread European elements and a few strictly Mediterranean entities (*Fridericia caprensis* Bell, 1947, *F. sardorum* Cognetti, 1901, *Enchytraeus christenseni bisetosus* Rota and Healy, 1994), apparently the only taxa tolerant of the aridity of soils and the degradation of the landscape affecting most coastal Mediterranean territories.

1.5. Results of the Research Journeys to Turkey

The 1987 and 1990 Turkish megadrile collections yielded 54 species and three subspecies, of which 16 were new to science, and increased the total number of earthworms known from the country to 70 species and six subspecies (Omodeo and Rota 1989, 1991, 1999). The data collected so far document only a part of the Turkish fauna and surely much work remains to be done; these data, however, hint at a peculiar situation: the earthworm genus *Dendrobaena* Eisen, 1874, dominates, counting 23 species (one-third of the total described worldwide), of which 14 are endemic. In other faunistic regions, *Dendrobaena* is strictly an inhabitant of woody habitats, typically

dwelling in the litter and top humic layers or in decaying logs, but in Anatolia — where the genus forms the largest portion of the soil communities — it apparently experienced an adaptive radiation: some species are specialized to live in pasture soils and cultivated fields and have relatively large body size (e.g., *D. pentheri* Rosa, 1905 and *D. bruna* Omodeo and Rota, 1989), whereas others live under moss or stones and show a much reduced body size, less than an inch in length, and other unusual morphological traits (e.g., *D. perula* Omodeo and Rota, 1989 and *D. fridericae* Omodeo and Rota, 1989).

More extraordinary appears the presence in this country of two lumbricid genera attributed by Omodeo and Rota (1989) to a new subfamily, the Spermophorodrilinae. This taxon includes so far 13 species, ten of which are restricted to Turkey, thus constituting the second largest portion of the autochthonous fauna. The Spermophorodrilinae are interesting because their peculiar morphology testifies to the lumbricid kinship to the Hormogastridae, which live in the western Mediterranean. Another two species, *Eophila cavazzutii* Omodeo, 1988 and *Eisenia grandis* Michaelsen, 1907, whose generic attribution is still a matter of inquiry (see proposals by Qiu and Bouché 1998c and Kvavdze 2000, respectively), complete the list of the autochthonous earthworms.

Beside the autochthonous biota, there is evidence that Anatolia hosts several species of Balkan origin. The following taxa, instead, appear to be absent or poorly represented, even though they are well represented in the Balkan Peninsula: the whole genera *Allolobophoridella* Mršić, 1990 and *Proctodrilus* Zicsi, 1985; the genus *Lumbricus* L., 1758, *L. rubellus* Hoffmeister, 1843 excepted; the genus *Octodrilus*, which is represented by its two most common species, *O. complanatus* (Dugès, 1828) and *O. transpadanus* (Rosa, 1884).

From soil samples collected during the 1990 campaign in western Anatolia, 27 species of enchytraeids have been identified and described, all but one new for the country and three new to science (Rota 1994a). The bulk of the collection was obtained from four well-preserved forest sites on the northern massif of Ulu Dag, while at most other localities the fauna was strikingly poorer. On the basis of the present records, beside the preservation of habitats, it would seem that the climatic and edaphic differences between the Black Sea coastland and the Aegean and Mediterranean sides of the country significantly affect the richness and distribution of enchytraeid species.

1.6. Results of the Research Trips to the Sardo-Corsican Archipelago

The results of the faunistic campaigns in Maghreb and Turkey are certainly interesting, but those obtained from the prospecting of the Sardo-Corsican system are more exciting. That was not perceived at once, because early studies had revealed the existence of endemic species in these islands (e.g., Michaelsen 1903); yet, as years went by, some of those species were found also in other parts of the Mediterranean and even in central Europe and the Canary Islands, so the interest went down and only later discoveries promoted it again.

Some twenty years ago, the megadrile species reported from Sardinia could be divided into three groups: (1) seven autochthonous species belonging to archaic lineages; (2) seven species of modern type; (3) six exotic invasive species, introduced by man in the last few centuries (Omodeo 1984). By that time, it was already apparent that the autochthonous fauna of the Sardo-Corsican system was akin to the Pyrenean fauna, and that Sardinia was richer in archaic species and poorer in modern species than Corsica (Omodeo and Rota 1987). The situation became more clearcut as the ongoing collections in Sardinia and lesser islands raised the number of old autochthonous species and subspecies to 14 (Rota 1992), whereas Corsica was shown to host 8 such taxa (Qiu and Bouché 1998d, e). Furthermore, a multivariate analysis of the abundant material collected in various areas of Sardinia, Corsica, Provence and the Tuscan Archipelago (Rota 1992) revealed that Sar-

dinia is faunistically fragmented, as if constituting an archipelago in itself; the isolation of Gallura (the northeastern corner of Sardinia) appeared particularly dramatic, as testified by an endemicity rate as high as 84% (the exotic peregrine species were excluded from the total), i.e. higher than for any area of similar size in the whole Palaearctic.

1.7. Analysis of the Autochthonous Fauna of the Sardo-Corsican System

The old autochthonous megadriles of the Sardo-Corsican system comprise three species of *Hormogaster* Rosa, 1887; the endemic subfamily Diporodrilinae Bouché, 1970; the endemic genus *Eumenescolex* Qiu and Bouché, 1998; some endemic species of *Scherotheca* and *Prosellodrilus*.

Earthworms of the genus *Hormogaster* are large or very large animals measuring up to 90 cm in length and weighing up to 100 g. The most remarkable aspect of their physiology is their tolerance of prolonged periods of drought thanks to a long diapause. *H. redii* combines this aptitude with an exceptionally wide ecological valence: it can inhabit sclerophyll woods, overgrazed pastures, stony lands, coarse granite sand, and even sandy beaches above the shoreline. This species, along with *Nicodrilus caliginosus* (Savigny, 1826), dominates the earthworm communities of Sardinia and lesser islands. In Corsica it is rare, occurring only on the northern tip of the island, whereas it is frequent in the eastern Tyrrhenian islands, Elba and Capraia excepted, and on the Tyrrhenian side of Italy from south of River Arno to 40°S. It appears again in Sicily and is well represented in North Africa — from Tunisia to the Edough promontory and adjacent lands of northeastern Algeria (Fig. 1). *Hormogaster pretiosa* Michael-sen, 1899 is endemic to the southwestern corner of Sardinia (Fig. 2), where it lives in damp clayey soils; the species was believed to occur in Spanish and French Catalonia as well, but Cobolli et al. (1992) and Rota (1994b) have provided genetic and morphological evidence for assigning the Catalan populations to the sister species *H. hispanica* Michaelsen, 1925 and *H. gallica* Rota, 1994. *Hormogaster samnitica* Cognetti, 1914, a close relative of the *H. pretiosa* complex, is widespread in Corsica, Elba and Capraia and in the Tuscan mainland to the south of River Arno (Fig. 2). Together with *H. redii*, it also inhabits the smaller islands of the Tuscan Archipelago and the Maddalena Archipelago (NE of Sardinia), whereas in Sardinia it is restricted to the coastland of Gallura. One isolated station in the Abruzzi gave this species its name.

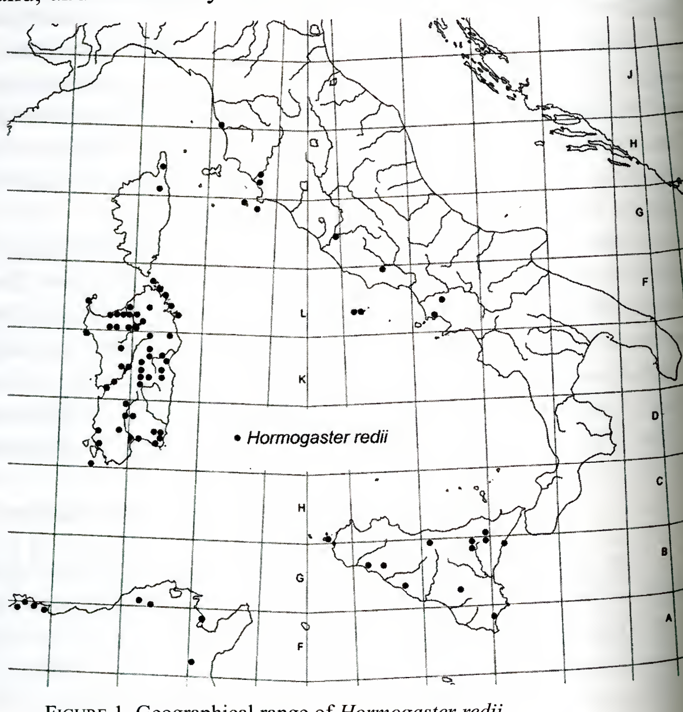

FIGURE 1. Geographical range of *Hormogaster redii*.

When first described, the endemic genus *Diporodrilus* Bouché, 1970, was allocated to a new family, the Diporodrilidae. Such classification was not accepted by other specialists, some of whom

(Sims 1980; Omodeo 1984) preferred to rank the taxon as a subfamily (Diporodrilinae) within the Lumbricidae; the same criterion is adopted here, in accordance with the peculiar anatomy of these animals. *Diporodrilus* comprises four species (Fig. 3): the largest in size, *D. pilosus* Bouché, 1970, is dominant in Gallura and adjacent small islands both by biomass and by number of specimens (290 in 21 sampling stations). *Diporodrilus omodeoi* Bouché, 1970 has a smaller size and is frequent in Corsica (Bouché 1970) but absent from Sardinia, where it is replaced by *D. bouchei* Omodeo, 1984, a closely related but less frequent species (52 specimens from three stations). The fourth species, still undescribed, is known through a single specimen found along the Tirso river near Oristano.

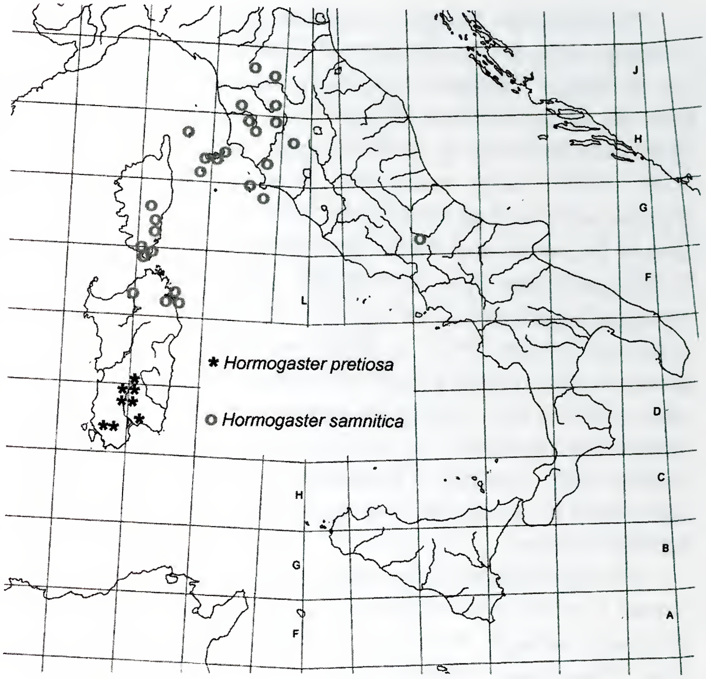

FIGURE 2. Geographical range of *Hormogaster pretiosa* and *H. samnitica*.

The genus *Eumenescolex* has a conspicuously fragmentary distribution (Fig. 4), its species surviving in restricted areas of the north-western Mediterranean: *E. heideti* Qiu and Bouché, 1998 and *E. emiliae* Qiu and Bouché, 1998 are known each from one station in Corsica, the first from two specimens, the second from three specimens. *Eumenescolex gabriellae gabriellae* (Omodeo, 1984) is known through 32 specimens collected from six stations on the Gennargentu Massif, whereas *E. gabriellae gallurae* (Omodeo, 1984) through 141 specimens from stations ranging from Gallura to Sarcidano (central western Sardinia). The fourth species, *E. pereli* (Bouché, 1972), is known from 24 specimens collected at one station near St. Tropez on the Maures Massif, Provence. Qiu and Bouché (1998d) classified in *Eumenescolex* a fifth taxon, *Allolobophora corsicana simplex* Zicsi, 1981 from Central Italy, that, however, fits only partially the diagnosis of the genus.

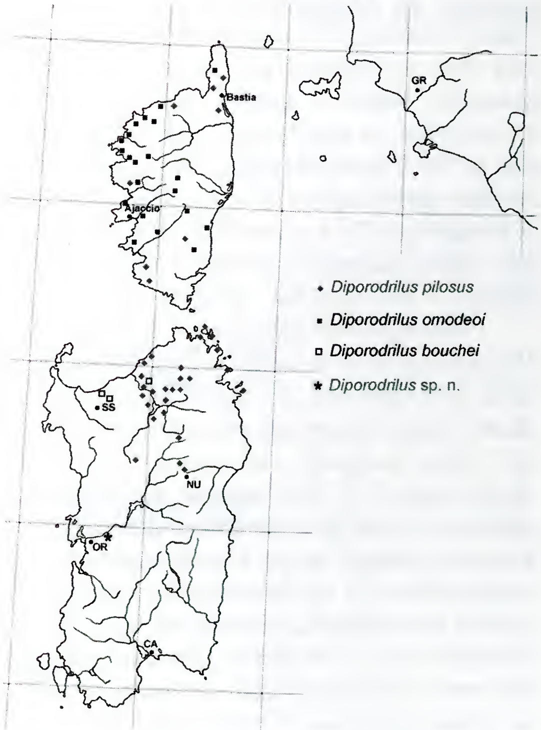

FIGURE 3. Geographical range of the Diporodrilinae.

Prosellodrilus inhabits Catalonia and the Pyrenees, with the exception of *P. doumandjii* and *P. festai*. The latter, originally described from the neighbourhood of Tunis, was shortly afterwards recorded in Sardinia near Cagliari (Rosa 1893). Later researches showed that *P. festai*, with its four subspecies, is very common in the centre and south of the island (Fig. 5; 330 specimens from 23 stations), almost as much as *H. redii* and *N. caliginosus*. This rather small earthworm bears a superficial resemblance to *Aporrectodea rosea* (Savigny, 1826), with which it also shares the habitat (mainly pastures with trees). In Sardinia lives also another, still unnamed, *Prosellodrilus* species discovered by us at the base of Mount Sette Fratelli (in prep.).

The distribution of the genus *Scherotheca* covers a wide area, which extends from the Pyrenees through Provence to the Western Alps. Throughout Corsica the genus is represented by *S. corsicana* (Pop, 1947), which also populates the Maddalena archipelago (northeastern Sardinia), but not the Sardinian mainland (Fig. 6). Interestingly, *S. targionii* (Baldasseroni, 1906), a species strictly akin to *S. corsicana*, is common on Elba Island and also in the Tuscan Maremma (Fig. 6). In the northern tip of Corsica lives *S. dugesi brevisella* Bouché, 1972, a subspecies of a polymorphic taxon endemic to Provence and western Liguria, *S. dugesi* (Rosa, 1896) (Fig. 7).

Pietromodeona januaeargenti (Cognetti, 1903) is common in central and southern Sardinia (159 specimens from 19 stations), but is absent from the northern part of the island. In the Italian peninsula this species has been found south of 42°20'N latitude, excluding the portion of Calabria south of the Pollino Massif; it is also common on the Tremiti Islands in the Adriatic Sea (Fig. 8). *Pietromodeona januaeargenti* is a polymorphic species, but it is difficult to divide it into subspecies; thus it appears all the more wrong to divide it into many species, as some specialists — who never saw these animals — suggest (see Omodeo and Rota 2004).

FIGURE 4. Geographical range of *Eumenescolex* species.

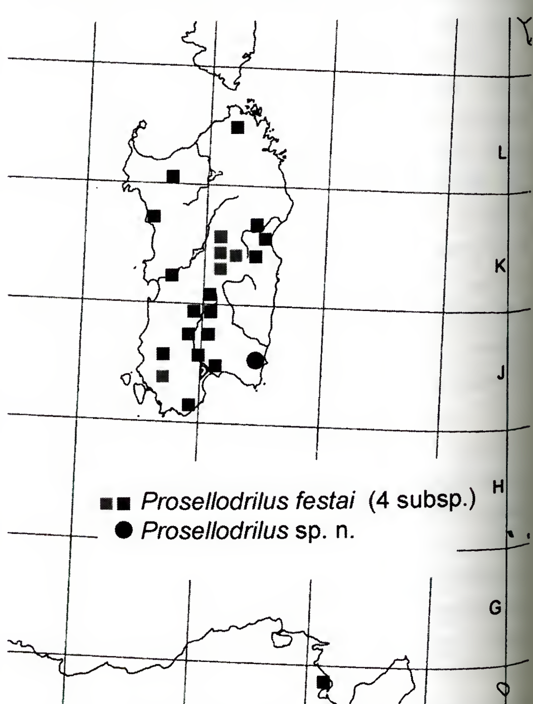

FIGURE 5. Geographical range of two Sardinian species of *Prosellodrilus*.

To the autochthonous fauna of Sardinia may also belong *Helodrilus massiliensis* Bartoli, 1962 and *Dendrobaena cognettii* Michaelsen, 1903. The former is an aquatic worm described from Provence and the Maritime Alps and recently found in Sardinia (unpublished data) but unknown from Corsica, an absence that should be viewed cautiously because aquatic earthworms are often overlooked (Fig. 7). The latter is a small straminicolous species belonging to the western branch of *Dendrobaena*, occurring in woods and scrublands of central and western Europe and Macharonesia. The subspecies, *D. cognettii gallurensis* Rota, 1992, is endemic of Gallura and southern Tuscany.

The absentees in Sardinia are conspicuous: the whole of the genera *Octodrilus, Octolasion* Örley, 1885, *Lumbricus, Allolobophora* Eisen, 1874 *s.s.*, *Allolobophoridella, Proctodrilus,* and *Eisenia*, all well represented on the Italian mainland, and most of the species ascribed to *Aporrectodea* and *Dendrobaena*. In Corsica, *Octolasion* and *Eisenia* are represented each by one species, and *Lumbricus* by three species. Other common genera are similarly absent.

2. Origins and History of the Faunas of the Three Districts

2.1. Correlation Between the Evolution of Megadrili and the Evolution of Their Homeland

The chronology of the separation of two landmasses provided by geologists and palaeogeographers can be a useful instrument to infer the divergence times of the populations that inhabited those landmasses. In reconstructing the history of the earthworm peopling of a territory, however, it must be considered that the genetic evolutionary rate of oligochaetes is much slower than that of many other animal groups (see Omodeo 1955; Wilcke 1955). The origin of the Lumbricoidea families according to Bouché (1972:485) may be dated to the Cretaceous or before, when Europe was isolated

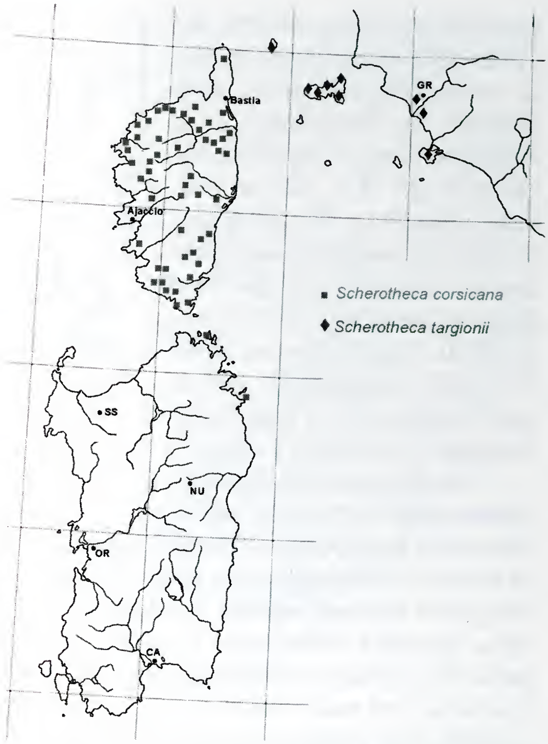

Figure 6. Geographical range of two *Scherotheca* species.

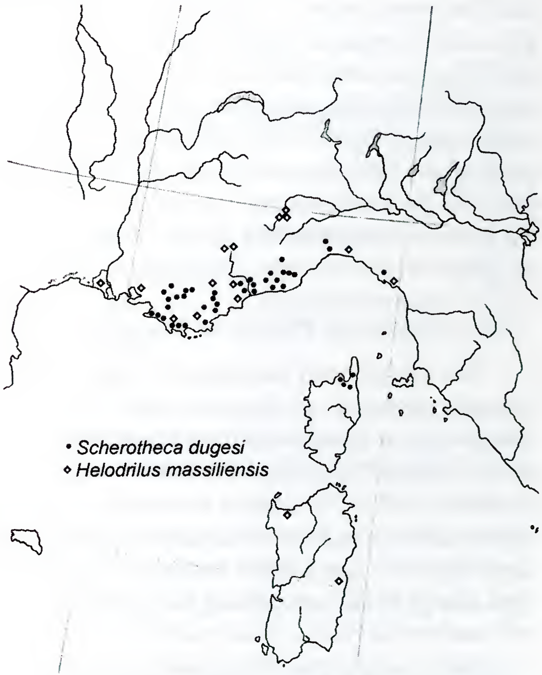

Figure 7. Geographical range of *Scherotheca dugesi* and *Helodrilus massiliensis*.

from Asia by a long sea arm. An earlier date would be preferable, as the modal amount of time required for the splitting of a megadrile genus is reliably estimated at 180 Myr; such an estimate is based on the divergence timings for endemic congeneric species occurring on the two shores of the Atlantic (see Omodeo 2000). That means that most, if not all, the megadrile genera here considered were already differentiated in the early Cenozoic.

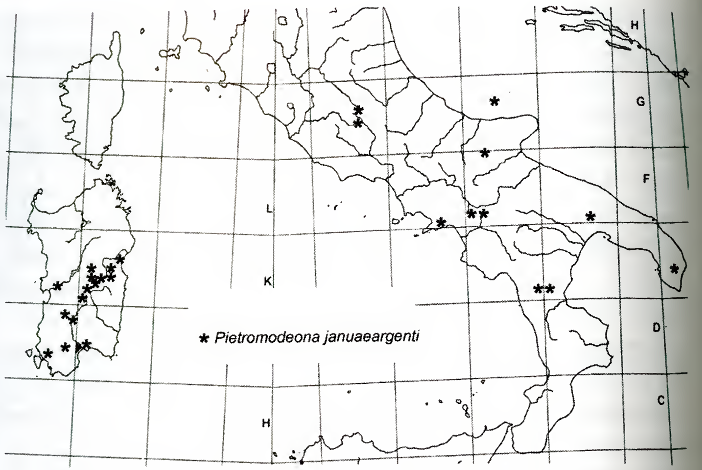

FIGURE 8. Geographical range of *Pietromodeona januaeargenti*.

The duration of allopatric speciation for earthworms, which came to be segregated on different fragments of the West-European landmass, has been investigated in the Hormogastridae; an allozyme analysis was conducted by Cobolli et al. (1992) to assess the genetic distance between populations of the *Hormogaster pretiosa* complex living in SW Sardinia, Spanish Catalonia and Roussillon (Pyrenées Orientales), as well as to compare the divergence time of these populations with the timing of the splitting of the Sardo-Corsican system from Catalonia. One result was that the sampled populations proved to be so genetically differentiated to justify their recognition at species level: *H. pretiosa, H. hispanica* and *H. gallica* (Cobolli et al. 1992; Rota 1994b). A second result was that the divergence timing between the Sardinian and the mainland populations — recalibrated according to Sarich (1977) — was 13–17.5 Myr, a time span quite short compared with the isolation times based on geological events (the most recent calculations place the detachment of the Corsica-Sardinia microplate at 24 Mya; see Andeweg 2002). Such inconsistency with geological data could only be explained by invoking slow molecular evolution in the taxon (Cobolli et al. 1992). That study also revealed an unsuspected high genetic divergence between the Spanish and French populations (which live only 60 km apart), even higher than that between the Sardinian and the two Catalan populations. Interestingly, palaeogeographic maps of the western Mediterranean at late Eocene (Fig. 9) show that the Spanish and French areas of the *H. pretiosa* complex were separated by the Ebro Basin.

2.2. Origins and History of Megadrile Populations in Western Mediterranean Countries

The territories of the Iberian Peninsula, Pyrenees, Maghreb and Sardo-Corsican system went through tormented geological history during the Cenozoic, subsequent to the closing of Neo-Tethys. These vicissitudes have been carefully reconstructed by geologists, so that today we have at our disposal detailed information on the changing palaeogeography of the last 60 Ma (see Andeweg 2002). To attempt to reconstruct the history of the megadriles of the western Mediterranean lands, it is good to start from the late Eocene (36 Mya), when Iberia was attached to Aquitania (France); the Sardo-Corsican block was attached to the Pyrenees; the Betico-Rifan system was a large island comprising the present-day Kabylias (Fig. 9). At this time all the extant genera of Lumbricidae were differentiated.

Based on the present distribution of the autochthonous earthworm fauna, we can hypothesize that the Pyrenees were the homeland of the genera *Orodrilus*, *Etnodrilus* and *Prosellodrilus*, while the more southern Sardo-Corsican system was the homeland of *Diporodrilus* and part of *Prosel-*

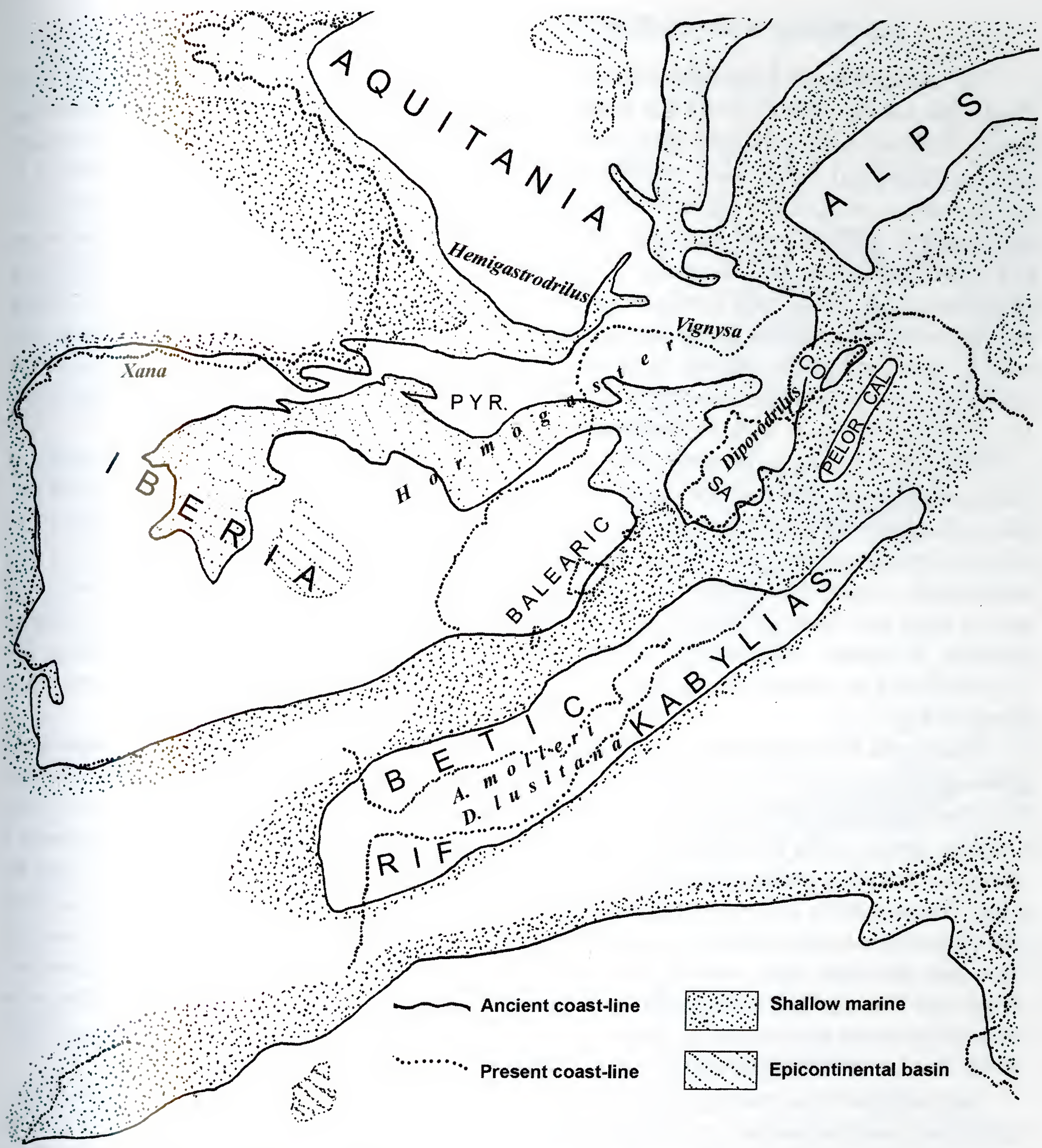

FIGURE 9. Palaeogeographic map of Western Mediterranean at Late Eocene (36 Mya). The Betico-Rifan system, including the two Kabylias, is detached from Iberia, whereas the Sardo-Corsican system is connected to the Pyrenées and further north to southern France — Aquitania (redrawn and modified from Andeweg 2002). CAL, Calabria; CO, Corsica; PELOR, Peloritani Massif; PYR, Pyrenées; SA, Sardinia.

lodrilus and *Eumenescolex*, the latter two genera being closely related. The Betico-Rifan system was instead the homeland of the *A. molleri* complex and *D. lusitana* Graff, 1961. We can also hypothesize that the complete set of the emerged western lands, the Betico-Rifan excluded, was the homeland of the Hormogastridae and of *Scherotheca* (Fig. 9).

During the Miocene and Pliocene, the tectonic setting of the Western Mediterranean changed and so did the topography and reciprocal connections between the above mentioned geographic territories and their earthworm populations.

2.3. History of the Earthworm Fauna of the Sardo-Corsican System

The autochthonous megadriles of Sardinia and Corsica form together an assemblage of 15 to 17 species: a level of biodiversity that is normal for a territory of 33,000 km^2 in the Mediterranean region. The ecological aptitudes represented in this assemblage were complementary and warranted the building and maintenance of stable communities, so that no adaptive radiation occurred. It is reasonable to believe that the present-day assemblage still represents a comprehensive sample of the megadrile lineages populating the south-western edge of Europe at the time of its detachment as a microplate in the late Oligocene, 27 Mya (Fig. 10). Most species dwelling in Sardinia had a Pyrenean origin, while most Corsican species originated from Provence or from Western Alpine territories that were already above sea level and close to northeastern (Alpine) Corsica. A land connection between Corsica and the mainland is herein hypothesized at 24 Mya (Fig. 11; Andeweg 2002), but later land bridges preceding the Messinian salinity crisis have also been suggested (Fig. 12; Orsag-Sperber et al. 1993; Meulenkamp and Sissingh 2003).

After breaking away from the continent, the Sardo-Corsican block became fragmented in a manner that has not entirely been clarified: during much of the time the southwestern corner of Sardinia was separated from the main body of the island by a sea arm, which would be filled later by alluvial deposits to form the Campidano Plain; *H. pretiosa* is endemic to that region (Fig. 2). The northeastern corner of Sardinia, i.e., Gallura, was connected to Corsica at times of low sea level, and, at least as a result of the degradation and loss of pristine forest habitats in adjacent parts of Sardinia, it became ecologically isolated from the rest of the island (Rota 1992): there live *D. pilosus* and *H. samnitica*, two species that are absent elsewhere in Sardinia but are common in Corsica (Figs 2, 3).

During the Messinian desiccation of the Mediterranean, a few species that could withstand the harsh conditions created by the high salinity levels of the former seafloor, expanded their ranges by following the forests to the east or southeast of Corsica and Sardinia. *H. samnitica*, starting from Corsica, spread along the Elban ridge separating Corsican and Montecristo basins, to colonize a vast area including present-day Elba and coastal Tuscany. Its relict populations inhabit today the small Tuscan islands that represent the summits of submarine mountains, in Messinian time rising like pinnacles over the dried up sea bottom (Fig. 2). *Scherotheca corsicana* used the same path and colonized the same land, evolving into a similar but distinct species, *S. targionii* (Baldasseroni, 1906) (see Omodeo and Rota 2005). Its main population lives today on Elba, while smaller populations live on the hills bordering western Tuscany. It has not been found so far in the lesser islands of the Tuscan Archipelago (Fig. 6).

Hormogaster redii outmigrated southwards from Sardinia to populate Tunisia and northwestern Algeria and eastwards to populate the western side of the Italian peninsula and Sicily (Fig. 1). The populations surviving today on the smaller islets rising out of the Tyrrhenian sea (but absent from Capraia and Elba) attest the route that was taken during this second migration. The two epochs of this spreading were placed by allozyme genetic studies at 8 Mya and 3 Mya, respectively (Cobolli et al. 1992). *Pietromodeona januaeargenti* followed, perhaps, the second path, populating southern Italy and the Tremiti Islands in the Adriatic Sea (Fig. 8). Both *H. redii* and *P. januaeargenti* are absent in Calabria south of the Pollino Massif.

It is possible that *Helodrilus massiliensis* found so far only in northern and western Sardinia arrived from the north (Fig. 7), even though it is not recorded in Corsica (aquatic megadriles are very often overlooked).

The last main geological event which affected the faunal composition of the northern Tyrrhenian lands was the lowering of the sea level during the Pleistocene Ice Age, when Corsica and Sar-

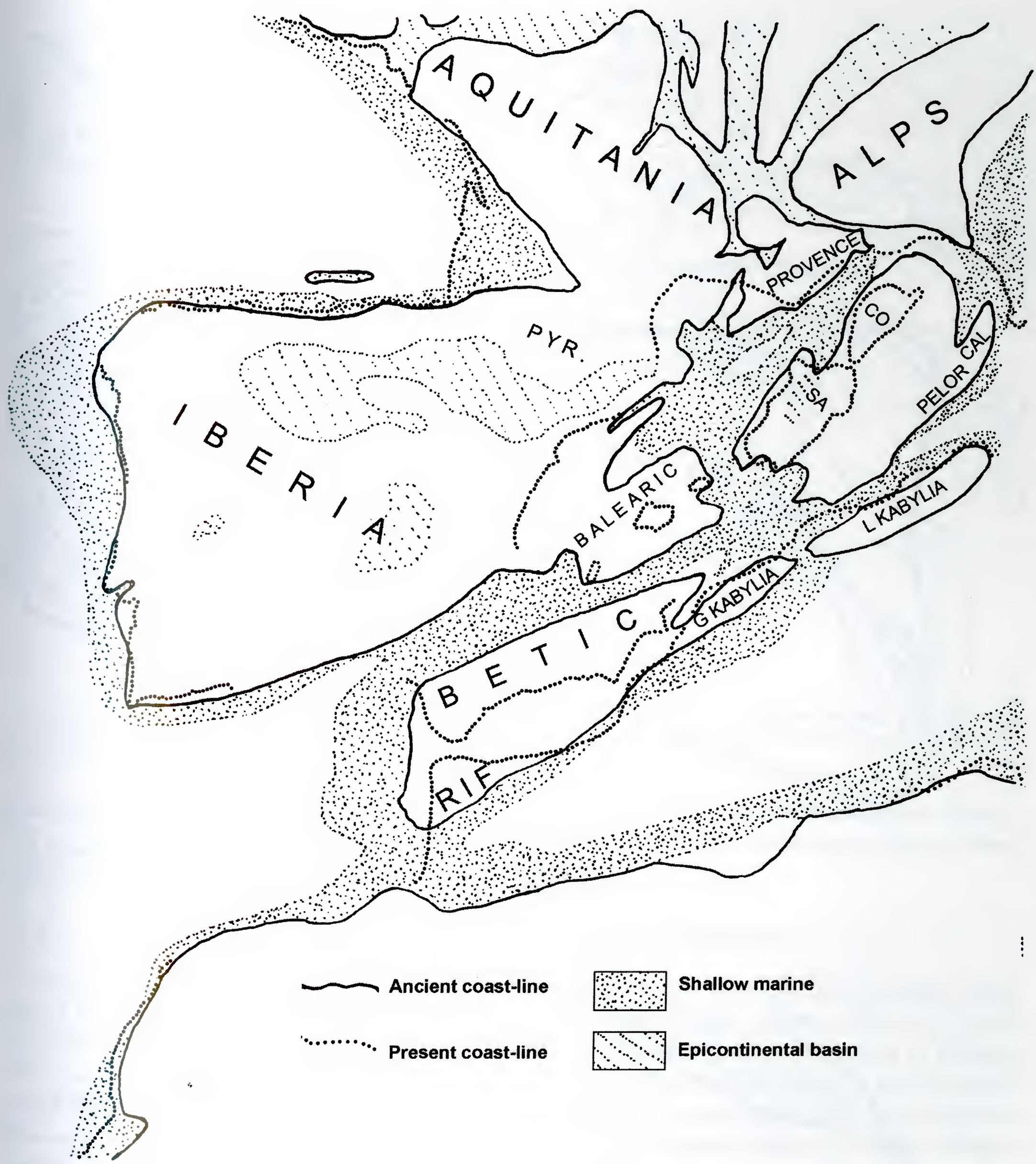

FIGURE 10. Palaeogeographic map of Western Mediterranean at Late Oligocene (27 Mya). The Sardo-Corsican system is completely separated from the Pyrenean region, but northern Corsica remains in close proximity to the Alps and Provence (redrawn and modified from Andeweg 2002). CAL, Calabria; CO, Corsica; PELOR, Peloritani Massif; PYR, Pyrenées; SA, Sardinia.

dinia were joined again by narrow tongues of land to Italy and possibly to Provence, too. This time the net migration direction was toward, not from, the Sardo-Corsican system. Sardinia received three parthenogenetic strains*, respectively of *N. caliginosus trapezoides*, *A. rosea bimastoides* and *Eiseniella tetraedra* (Savigny, 1826), but the two latter did not become so frequent as on the European continent. In Corsica, five more species arrived and thrived: *Allolobophora chlorotica* (Savi-

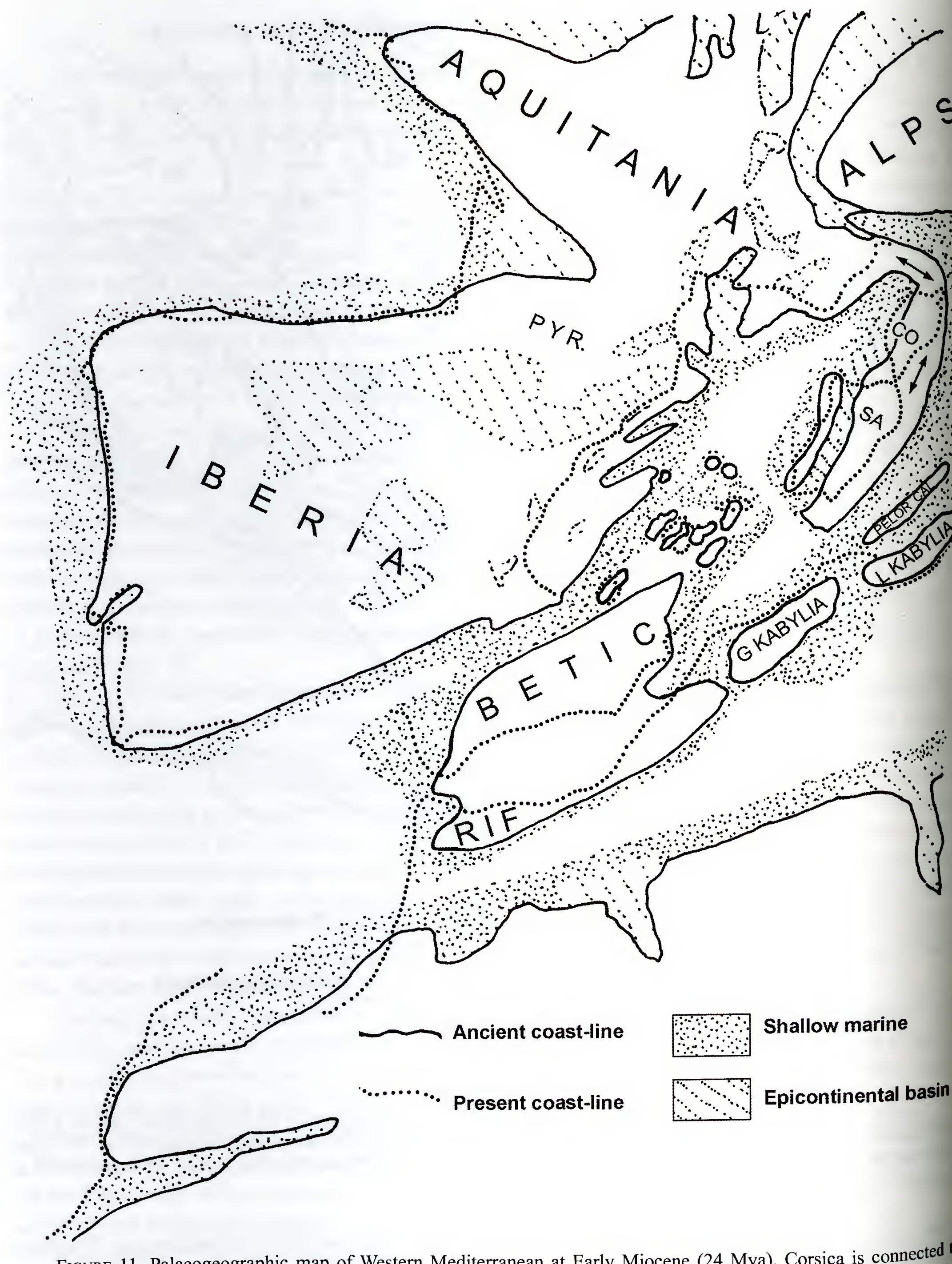

FIGURE 11. Palaeogeographic map of Western Mediterranean at Early Miocene (24 Mya). Corsica is connected to Provence and the Alps. The Calabro-Peloritani massif has broken away from the Sardo-Corsican block. The Betico-Rifan block is fragmented and migrates eastwards (redrawn and modified from Andeweg 2002). Double arrows indicate the possible migration routes of Eumenescolex, Scherotheca and Helodrilus. CAL, Calabria; CO, Corsica; PELOR, Peloritani Massif; PYR, Pyrenées; SA, Sardinia.

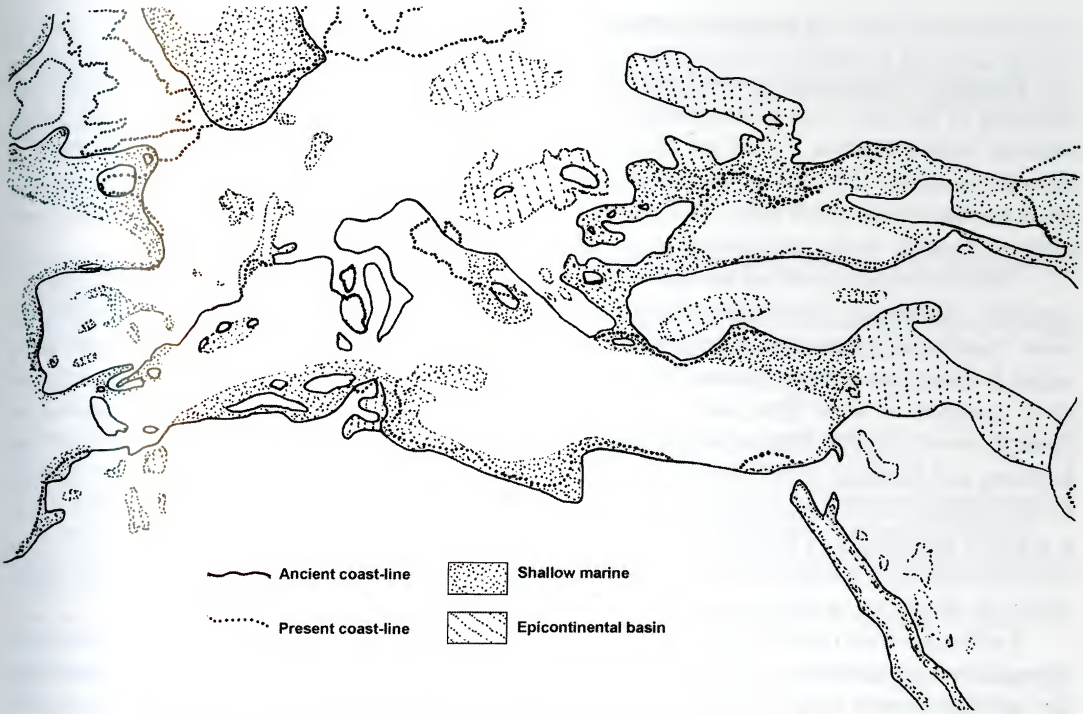

FIGURE 12. Palaeogeography of the Mediterranean at Late Miocene (Tortonian, 7–8 Mya) according to Meulenkamp and Sissingh (2003). The isolation of Turkey from Greece and the Balkans is evident. Note also the hypothetical relationships of the Sardo-Corsican system.

gny, 1826), *Lumbricus castaneus* (Savigny, 1826), *O. complanatus, Octolasion lacteum* (Örley, 1885) and *Proctodrilus antipai.* It is possible that such a large contingent of modern species caused the disappearance of some archaic species from this island.

2.4. History of the Earthworm Fauna of Maghreb

The autochthonous species presently living in Maghreb are not numerous and belong to three groups. The first comprises the *A. molleri* complex and *Dendrobaena lusitana*. Both live in the south of Iberia, in the two Kabylias and on the Canary Islands, whereas they are absent in Tunisia; thus it can be assumed that they belong to the old fauna of the Betico-Rifan system, and that their present distribution reflects that of late Eocene (Fig. 9). It is noteworthy that *Allolobophora dubiosa* (Örley, 1881), a species close to *A. molleri*, lives in the Balkan Peninsula and in northern Anatolia and that *A. molleri* is replaced in Tunisia by a vicariant form related to *Nicodrilus*. The second group comprises two archaic species: *P. doumandjii* and *P. festai* (Fig. 5), living respectively in the environs of Algiers and Tunis, but belonging to two different lineages whose paleohistories are not yet understood. The same may be said of *A. borellii,* which was described from one site in the Pyrenees and is rather frequent in Morocco and eastern Algeria. The third group includes three endemic species: *Octodrilus kabilianus* and *O. maghrebinus* from central and eastern Algeria and Tunisia, together with *E. xylophila*, which inhabits the decaying logs of cork oak; these species have their nearest relatives in the Balkan Peninsula. *Dendrobaena byblica* and *H. redii* came to Maghreb from Anatolia and Sardinia, respectively, during the salinity crisis of 5.96–5.33 Mya, possibly together with modern type species such as *A. eiseni, M. minuscula* and *P. antipai* (see above).

2.5. History of the Anatolian Earthworm Fauna

The story of the Anatolian earthworm fauna has been outlined by Omodeo and Rota (1999) on the basis of the 1987 and 1990 collections. Later records (Misirlioğlu 2004; Csuzdi et al. 2006) increase local definition but do not change the faunistic scenario. However, the results emerging from the analyses of the other Mediterranean districts suggest a better organization of the conclusions reached in the 1999 paper. It is possible to recognize three successive episodes in the peopling of Anatolia by the megadriles, all of them connected with main geological events.

The first episode involved the Spermophorodrilinae, a taxon showing affinity with the Hormogastridae, inhabiting southwestern Europe, and with the Diporodrilinae, inhabiting the Sardo-Corsican system. All three taxa, along with the older Criodrilidae, are the relict of a remote fauna which lived on the northern coasts of Palaeotethys and populated Anatolia when this Gondwanian plate emerged as terra firma and collided with Eurasia during the Cretaceous as asserted by Stampfli et al. (2002). The palaeogeographic scenarios provided by these authors and by Meulenkamp and Sissingh (2003) show that from the Oligocene onwards Turkey remained connected to the Balkans, the Dinaric system and the Alps, except for a break during the upper Miocene, when a sea-arm separated two continental masses once called North- and South-Aegeid (Fig. 12). This scenario aids us to interpret the peopling of Anatolia by the European genus *Dendrobaena*, which is so rich in species in both Anatolia and the Balkan peninsula.

The last episode occurred during the Pleistocene, when a wider connection between Tracia and Anatolia was established. In such a circumstance many species migrated southward and populated the northern coastal strip of Anatolia. This strip was wider then, because during the Ice Age the Black Sea was separated from the Mediterranean and its level lowered by about 100 m because of evaporation. When 7150 years ago (date *fide* Ryan et al. 1997), the connection between the two seas was re-established, these species remained confined in the area between Cape Ince and the Lazistan, the Colchis, or in the area south of Marmara Sea.

Conclusions

The evidence gained from the study of old and recent earthworm collections in the Mediterranean, together with earlier interpretative efforts about the history of the populations of particular areas, allowed us to correlate the present distribution of old autochthonous species with the geological and climatic vicissitudes of the Mediterranean basin. Using such correlation, we have formulated hypotheses concerning some aspects of the phylogeny of an animal group which leaves very few fossil remains.

The above reconstructions of the history and relationships of the megadrile fauna of three Mediterranean districts represents a consistent, durable result. Much work, however, remains to be done. First, the inference of a well supported phylogeny based on both morphological and molecular data. Second, the temporal calibration of phylogenetic trees. Third, a thorough investigation of the ongoing or completed processes of differentiation at subspecific and specific levels, as revealed by morphological research.

Acknowledgments

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Literature Cited

ALVAREZ, W., T. COCOZZA, AND F.C. WEZEL. 1974. Fragmentation of the Alpine orogenic belt by microplate dispersal. *Nature* 248:309–314.

ANDEWEG, BERND. 2002. *Cenozoic Tectonic Evolution of the Iberian Peninsula, Causes and Effects of Changing Stress Fields.* Ph.D. thesis. Vrije Universiteit Amsterdam, Amsterdam, Netherlands. 178 pp.

BAHA, M., AND S. BERRA. 2001. *Prosellodrilus doumandjii* n. sp., a new lumbricid from Algeria. *Tropical Zoology* 14:87–93.

BENHAM, W.B. 1922. Oligochaeta of Macquarie Island. *Australian Antarctic Expedition 1911–1914, Scientific Reports* 6:1–38.

BOUCHÉ, M.B. 1970. Remarques sur quelques Lumbricina de France et consequences de la découverte des nouveaux taxons Vignysinae (Subfam. nov.) et Diporodrilidae (Fam. nov.). *Pedobiologia* 10:246–256.

BOUCHÉ, M.B. 1972. *Lombriciens de France. Ecologie et systématique.* Annales de Zoologie-Ecologie Animale, numéro hors-série. 671 pp.

ČERNOSVITOV, L. 1932a. *Einfluss der Eiszeit auf die Zusammensetzung der jetzigen Fauna der Tschechoslovakei.* Praha, Czechoslovakia. 83 pp.

ČERNOSVITOV, L. 1932b. Die Oligochaetenfauna der Karpathen. II. Die Lumbriciden und ihre Verbreitung. *Zoologische Jahrbucher – Abteilung für Systematik, Okologie und Geographie der Tiere* 62:525–546.

ČERNOSVITOV, L. 1935. Monografie ceskoslovenskych destovek. Monographie der tschechoslovakischen Lumbriciden. *Archiv pro přírodovědecký výzkum Čech*, 19:1–86. (In German; Czech introduction.).

ČERNOSVITOV, L. 1936. Notes sur la distribution mondiale de quelques Oligochètes. *Mémoires de la Société zoologique tchecoslovaque* 3:16–19.

ČERNOSVITOV, L., AND A.C. EVANS. 1947. *Lumbricidae (Annelida). With a key to the common species.* Synopses of the British Fauna. No. 6. The Linnaean Society of London, London, UK. 36 pp.

COBOLLI SBORDONI, M., E. DE MATTHAEIS, A. ALONZI, M. MATTOCCIA, P. OMODEO, AND E. ROTA. 1992. Speciation, genetic divergence and palaeogeography in the Hormogastridae. *Soil Biology and Biochemistry* 24(12):1213–1221.

CSUZDI, CS., A. ZICSI, AND M. MISIRLIOĞLU. 2006. An annotated checklist of the earthworm fauna of Turkey (Oligochaeta: Lumbricidae). *Zootaxa* 1175:1–29.

GRAFF, O. 1953. *Die Regenwürmer Deutschlands.* Schriftenreihe der Forschungsanstalt für Landwirtschaft Braunschweig-Völkenrode, Heft 7. M. & H. Schaper, Hannover, Germany. 81 pp.

HEALY, B., AND E. ROTA. 1992. Methods for collecting Enchytraeidae during expeditions. *Soil Biology and Biochemistry* 24(12):1279–1281.

JULIN, E. 1949. De svenska daggmaskarterna. *Arkiv för zoologi* 42(A):1–58.

KVAVADZE, E. 2000. New genus of earthworms *Dendrodriloides* gen. nov. (Oligochaeta, Lumbricidae). *Bulletin of the Georgian Academy of Sciences* 161(2):344–346.

MEULENKAMP, J.E., AND W. SISSINGH. 2003. Tertiary palaeogeography and tectonostratigraphic evolution of the Northern and Southern Peri-Tethys platforms and the intermediate domains of the African–Eurasian convergent plate boundary zone. *Palaeogeography, Palaeoclimatology and Palaeoecology* 196:209–228.

MICHAELSEN, W. 1902. Der Einfluss der Eiszeit auf die Verbreitung der Regenwürmer. *Verhandlungen des naturwissenschaftliche Vereins zu Hamburg* 9(3):62–65.

MICHAELSEN, W. 1903. *Die geographische Verbreitung der Oligochaeten.* Friedländer & Sohn, Berlin, Germany. 186 pp.

MICHAELSEN, W. 1922. Die Verbreitung der Oligochäten im Lichte der Wegener'schen Theorie der Kontinentenverschiebung und andere Fragen zur Stammesgeschichte und Verbreitung dieser Tiergruppe. *Verhandlungen des naturwissenschaftliche Vereins zu Hamburg* 29(3):45–79.

Misirlioğlu, M. 2004. Earthworm records from different parts of Anatolia. *Megadrilogica* 10:1–4.

Omodeo, P. 1952. Particolarità della zoogeografia dei lombrichi. *Bollettino di Zoologia* 19:349–369.

Omodeo, P. 1954. Aspetti biogeografici della speciazione. *Bollettino di Zoologia* 21:549–605.

Omodeo, P. 1955. Nuove specie dei generi a distribuzione anfiatlantica *Wegeneriella* e *Neogaster* (Acanthodrilidae, Oligochaeta). *Annuario dell'Istituto e Museo di Zoologia dell'Università di Napoli* 7:1–29.

Omodeo, P. 1963. Distribution of the terricolous oligochaetes on the two shores of the Atlantic. Pages 127–151 *in* A. Löve and D. Löve, eds., *North Atlantic Biota and Their History*. Pergamon Press, Oxford, UK.

Omodeo, P. 1984. The earthworm fauna of Sardinia. *Revue d'Ecologie et Biologie du So* 21:115–126.

Omodeo, P. 2000. Evolution and biogeography of megadriles (Annelida, Clitellata). *Italian Journal of Zoology* 67:179–201.

Omodeo, P., and E. Rota. 1987. Caractères originaux des peuplements des îles tyrrhéniennes en Oligochètes terricoles. *Bulletin de la Société Zoologique de France* 112(1–2):197–214.

Omodeo, P., and E. Rota. 1989. Earthworms of Turkey. *Bollettino di Zoologia* 56:167–199.

Omodeo, P., and E. Rota. 1991. Earthworms of Turkey. II. *Bollettino di Zoologia* 58:171–181.

Omodeo, P., and E. Rota. 1999. Biogeographical patterns of terricolous oligochaetes in Turkey (Annelida: Clitellata: Lumbricidae, Enchytraeidae). *Biogeographia – Lavori Società Italiana di Biogeografia* 20 (1999):61–79.

Omodeo, P., and E. Rota. 2004. Observaciones taxonomicas sobre las lombrices de tierra de los Alpes Occidentales/Taxonomic remarks on the earthworms inhabiting the Western Alps. Pages 189–259 *in* A.G. Moreno and S. Borges, eds., *Avances en taxonomia de lombrices de tierra/Advances in earthworm taxonomy* (*Annelida: Oligochaeta*). Editorial Complutense, Madrid, Spain. (Spanish/English).

Omodeo, P., and E. Rota. 2005. Speciography and intrapopulation variability in lumbricids. Pages 3–16 *in* V.V. Pop and A.A. Pop, eds., *Advances in earthworm taxonomy II* (*Annelida: Oligochaeta*). Cluj University Press, Cluj-Napoca, Romania.

Omodeo, P., E. Rota, and M. Baha. 2003. The megadrile fauna (Annelida: Oligochaeta) of Maghreb: a biogeographical and ecological characterization. *Pedobiologia* 47(5–6):458–465.

Orszag-Sperber, F., J. Butterlin, J. Clermonte, M. Colchen, R. Guiraud, A. Poisson, and L.E. Ricou. 1993. Tortonian Palaeoenvironments (11.5–6 Ma) and map. Pages 237–239 *in* J. Dercourt, L.E. Ricou, B. Vrielynck, eds., *Atlas Tethys, Paleoenvironmental Maps*. Gauthier-Villars, Paris, France.

Perel, T.S. 1979. *Range and Regularities in the Distribution of Earthworms in the USSR Fauna*. Nauka, Moscow, Russia. 272 pp. (In Russian.)

Pop, V. 1948. Lumbricidele din Romania. *Analele Academiei Romane, Sectiunea de Stiinte Geologice, Geografice si Biologice*, ser. A, 1:1–125.

Qiu, J.P., and M.B. Bouché. 1998a. *Hydrilus*, un remarquable nouveau genre de Lumbricidae (Annelida: Oligochaeta). *Documents pédozoologiques et intégrologiques* 4:17–19.

Qiu, J.P., and M.B. Bouché. 1998b. *Heraclescolex*, un nouveau genre de Lumbricidae (Annelida: Oligochaeta). *Documents pédozoologiques et intégrologique* 4:140–152.

Qiu, J.P., and M.B. Bouché. 1998c. Révision des taxons supraspécifiques de Lumbricoidea. *Documents pédozoologiques et intégrologiques* 3:179–216.

Qiu, J.P., and M.B. Bouché. 1998d. *Eumenescolex*, nouveau genre de Lumbricidae (Annelida, Oligochaeta). *Documents pédozoologiques et intégrologiques* 4:3–7.

Qiu, J.P., and M.B. Bouché. 1998e. Révision morphologique, chorologique et taxonomique du genre *Scherotheca* Bouché, 1972 (Oligochaeta: Lumbricidae). *Documents pédozoologiques et intégrologiques* 4:117–139.

Rosa, D. 1893. Revisione dei Lumbricidi. *Memorie dell'Accademia delle Scienze di Torino*, (2) 43:339–476.

Rota, E. 1992. New data on the earthworm fauna of Gallura (Northeast Sardinia). *Soil Biology and Biochemistry* 24(12):1383–1388.

Rota, E. 1994a. Enchytraeidae (Oligochaeta) of western Anatolia: taxonomy and faunistics. *Bollettino di Zoologia* 61(3):241–260.

Rota, E. 1994b. Contribution to the taxonomy of the Hormogastridae (Annelida: Oligochaeta) with description of two new species from southern France. *Journal of Natural History* 28:27–36.

ROTA, E. 1995. Italian Enchytraeidae (Oligochaeta). I. *Bollettino di Zoologia* 62(2):183–231.

ROTA, E., AND B. HEALY. 1994. The enchytraeid fauna of North Africa. *Hydrobiologia* 278:53–66.

ROTA, E., AND P. OMODEO. 1992. Phylogeny of Lumbricina: re-examination of an authoritative hypothesis. *Soil Biology and Biochemistry* 24(12):1263–1277.

RYAN, W.B.F., W.C. PITMAN III, C.O. MAJOR, K. SHIMKUS, V. MOSKALENKO, G.A. JONES, P. DIMITROV, N. GORIIR, M. SAKING, AND H. YIICE. 1997. An abrupt drowning of the Black Sea shelf. *Marine Geology* 138:119–126.

SARICH, V.M. 1977. Rates, sample sizes, and the neutrality hypothesis for electrophoresis in evolutionary studies. *Nature* 265:24–28.

SIMS, R.W. 1980. A classification and the distribution of earthworms, suborder Lumbricina (Haplotaxida: Oligochaeta). *Bulletin of the British Museum of Natural History* (*Zoology*) 39:103–124.

STAMPFLI, G.M., G.D. BOREL, R. MARCHANT, AND J. MOSAR. 2002. Western Alps geological constraints on western Tethyan reconstructions. Pages 77–106 *in* G. Rosenbaum and G. S. Lister, eds., *Reconstruction of the Evolution of the Alpine-Himalayan Orogeny. Journal of the Virtual Explorer*, 8.

STÖP-BOWITZ, C. 1969. A contribution to our knowledge of the systematics and zoogeography of Norwegian earthworms (Annelida, Oligochaeta: Lumbricidae). *Nytt Magazin for Zoologi* 17:169–280.

WILCKE, D.E. 1955. Bemerkungen zum Problem des erdzeitlichen Alters der Regenwürmer (Oligochaeta opisthopora). *Zoologischer Anzeiger* 154:149–156.

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Herpetological Explorations of the Balearic Islands During the Last Two Centuries

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Knowledge of Balearic amphibians and reptiles is closely linked to the development of European herpetology itself. The first herpetological study of the Balearic Islands was made at the end of the 18th century and during the first decades of the 19th century. We divide herpetological explorations of the Balearic Islands into three periods: first, a general approach by local naturalists and travellers; second, scientific exploration of the archipelago by professional collectors and herpetologists from the most important European museums and universities, with studies mainly focused on systematics and taxonomy; and third, scientific description of evolutionary processes observed on islands and their relationship to emergent disciplines such as island biogeography and insular ecology. In this work, we review these most important steps in the development of herpetological knowledge of the Balearic Islands from two different and complementary approaches: the origin, personality and objectives of researchers, and the discoveries they made during more than two centuries.

Riassunto

La conoscenza delle specie di Anfibi e Rettili delle Baleari è strettamente connessa allo sviluppo dell'erpetologia europea. Il primo vero studio sulle specie erpetologiche delle Baleari, risale alla fine del XVIII secolo e alle prime decadi del XIX secolo. Le esplorazioni erpetologiche di queste isole possono essere suddivise nei tre seguenti periodi: un primo, relativo a un approccio molto generale a questa disciplina, si è avuto grazie a naturalisti e viaggiatori locali; un secondo, dedicato alle esplorazioni scientifiche dell'arcipelago, è stato intrapreso da raccoglitori ed erpetologi professionisti provenienti dalle università e dai musei più importanti d'Europa, con studi prevalentemente incentrati sulla sistematica e la tassonomia; e un terzo periodo dedicato alla descrizione scientifica dei processi evolutivi osservati sulle isole e la loro relazione con discipline emergenti quali la biogeografia e l'ecologia insulari. Nel presente lavoro sono presentati i passi più importanti dello sviluppo delle conoscenze erpetologiche relative alle Isole Baleari, si affrontata no pertanto l'origine, la personalità e l'obiettivo dei singoli ricercatori da un lato e, dall'altro, le scoperte da loro fatte durante un periodo della durata di oltre due secoli.

Resumen

El conocimiento de los anfibios y reptiles de las Islas Baleares ha estado ligado al propio desarrollo de la herpetología europea. Las primeras contribuciones al conocimiento de la herpetofauna balear tuvieron lugar en las postrimerías del siglo

XVIII y las primeras décadas del XIX. Podemos dividir la exploración herpetológica de las Islas Baleares en tres períodos diferentes: Una primera aproximación por parte de naturalistas locales y viajeros, un segundo período de exploración científica del archipiélago de colectores profesionales y herpetólogos de los más importantes museos y universidades de Europa, principalmente interesados en la sistemática y la taxonomía y un tercer período de descripción científica del proceso evolutivo observado en las islas y su relación con disciplinas emergentes como la biogeografía y la ecología insular. En este trabajo presentamos los hitos más relevantes en el desarrollo del conocimiento herpetológico de las islas Baleares desde dos ópticas complementarias, el origen, personalidad y objetivos de los investigadores por un lado y los descubrimientos que llevaron a cabo durante más de dos siglos por otro.

The herpetological exploration of the Balearic Islands has been an exciting intellectual and scientific adventure involving the majority of European herpetologists for more than two hundred years. The history of this exploration has received little attention, and only a few short summaries are available (Montori et al. 1985; Vives-Balmaña 1987; Böhme 2004; Pérez-Mellado 2005). The knowledge of amphibians and reptiles of the Balearic Islands was closely linked to the development of European herpetology itself, and during the 19th and 20th centuries most of its leading figures explored or studied the Balearic herpetofauna.

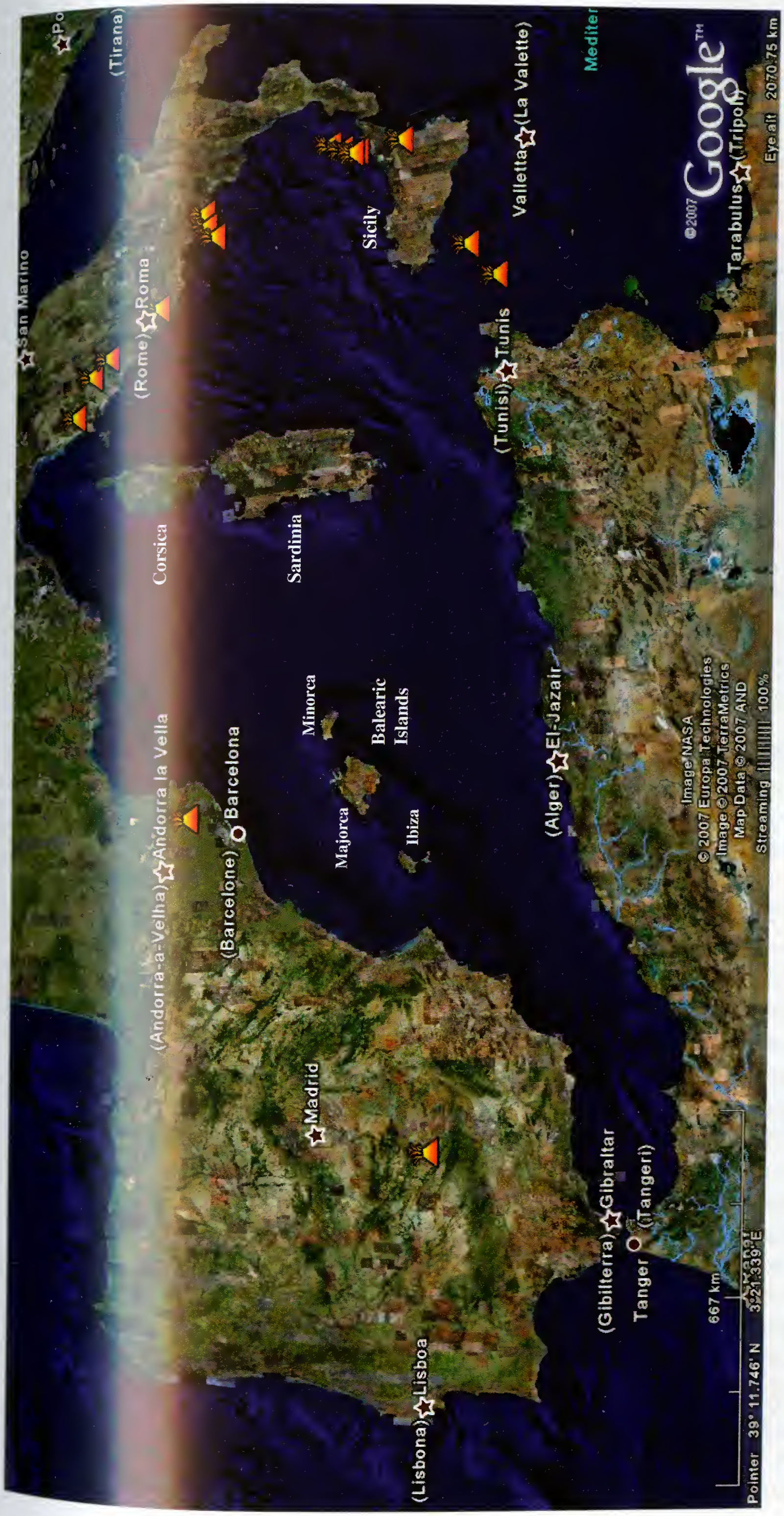
We can divide the herpetological exploration of Balearic Islands into three periods: first, the very general approach taken by local naturalists and travellers; second, scientific exploration of the archipelago by professional collectors and herpetologists from European museums and universities, mainly focusing on systematics and taxonomy; and third, scientific description of the evolutionary processes observed on the islands and their relationship to the emerging disciplines such as island biogeography and insular ecology.

Why did so many important herpetologists visit the Balearic Islands during the last two centuries? Were attracted by the exotic nature of the region and its sunny weather? Were they seeking a geographical area inhabited by a diverse and undescribed fauna? The answer to the latter two questions, in response to the first, is probably yes, but . . . the herpetofauna of the Balearic Islands is fairly poor, in comparison to other larger Mediterranean islands or with adjacent continental areas. In fact, most of Balearic amphibians and reptiles are introduced and are more common in other places, although this fact has not always recognized (see below). Thus, we have to search for reasons that are probably linked to the development of modern zoology during the second half of the 19th century and, particularly, with the increasing influence of the evolutionary thought after the publication of the *Origin* by Darwin. Indeed, research on the Balearic Islands included not only formal and traditional systematics but also the exploration of evolutionary topics that related to the main theoretical questions raised by Darwin.

The history of herpetological studies of the Balearic Islands is clearly biased towards Menorca Island, with less information concerning Mallorca than Menorca. Thus, our present-day knowledge is a consequence of the availability of historical documents and the limited exploration of Mallorca and Ibiza. This is probably a result of the higher intellectual, scientific, and cultural activity on Menorca in comparison to the other islands of the archipelago, at least toward the end of the 18th and all of the 19th century (Vidal Hernández 2002).

First Period: A Basic Look on Faunas

If we exclude anecdotal comments found in travel books and general descriptions of the Balearic Islands, the first scientific commentaries on the islands' fauna and flora are found in offi-



The Western Mediterranean showing the relations of the Balearic Islands to the mainland and neighboring islands, including Corsica, Sardinia, and Sicily. Courtesy Google Earth, 2007.

cial documents and observations from the 18th century, by Spanish officials for Mallorca and Ibiza, and military officers and British administrators for Menorca. The Scottish physician George Cleghorn (1716–1789), who served as surgeon of the 22nd Foot Regiment, published a book with observations on endemic and epidemic diseases, plants, and animals of Menorca (Cleghorn 1751). Unfortunately, amphibians and reptiles are not mentioned in his book, which can be considered the first account of the natural history of the Balearic Islands (Pérez-Mellado 2005). In 1752, John Armstrong published a volume titled *The History of the Island of Menorca* (Spanish translation in Armstrong 1781) in which, for the first time, we can read some comments with regard to amphibians and reptiles of Menorca Island. To the best of our knowledge, this is the first contribution to the knowledge of amphibians and reptiles of Balearic Islands. Armstrong was a military engineer with a wide range of interests (Vidal Hernández 2005); he described terrestrial tortoises as well as the abundant lizards inhabiting Menorca.

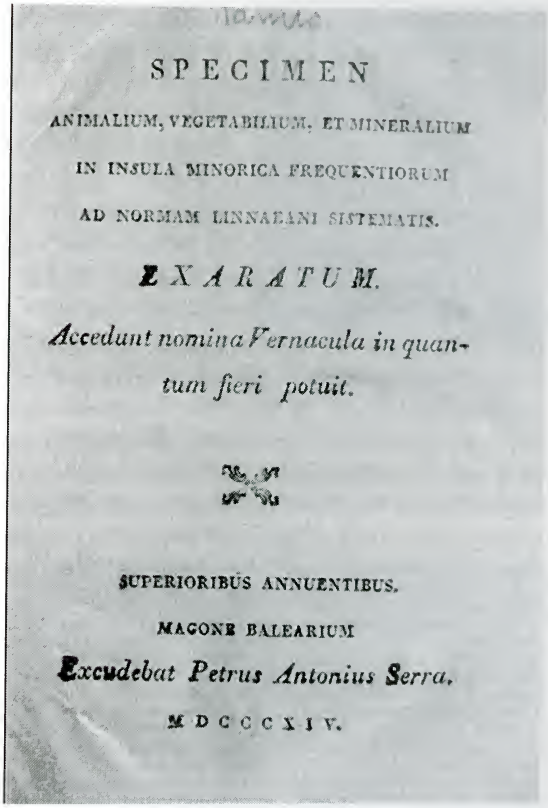
In 1787, an anonymous catalogue of six pages appeared in Menorca with the title *Catalogus plantarum, Arborum, Arbusculorum, Piscium, Animalium terrestrium et Insectorum et Mineralium Secundum Systema Linnearum Exaratum,* later reprinted by Castaños (1943 and 1944). Supposedly, the author of this book was Joan Ramis i Ramis (1746–1819), a lawyer, writer, and archaeologist (Fig. 1), who probably assembled the *Catalogus* by copying and enlarging the previous book of Cleghorn (Vidal Hernández 1999). A second version of the *Catalogus,* written in 1788, was published in 1814 (Fig. 2). It, too, was signed by Joan Ramis (Ramis, 1814), but the improvement of this new version was so great that Vidal Hernández (1999) was led to suggest that Ramis' brother, Bartolomeu Ramis (1751–1837), a medical doctor, actively participated in its preparation. In the first version of the *Catalogus*, we can readily recognize some of the species such as the loggerhead turtle, recorded as *Testudo marina,* placed within the group *Pisces Testacei*, and *Rana* (*Hyla meridionalis*?), *Stellio* (*Tarentola mauritanica*?), *Testudo* (*Testudo hermanni*?), *Bufo* (*Bufo viridis*?), *Lacertus viridis caudata bifida, Lacertus vulgaris* and *Anguis Esculapii*, all placed within the group called *Animalia terrestria frequentiora*. The version published in 1814 had a better systematic arrangement, including among the Reptiles, the sea turtle, as *Testudo mydas* (*Caretta caretta*), the pond turtle, *Testudo lutaria* (*Emys orbicularis*), the terrestrial turtle, *Testudo graeca* (*Testudo hermanni*), *Rana Bufo* (which we can surely identify as the green toad, *Bufo viridis,* because Ramis, for the first time, employed the current Minorcan name of the species: *calàpet*), *Rana temporaria, Rana esculenta, Rana arborea* (*Hyla meridionalis*), *Lacerta vulgaris*, *Lacerta aquatica,* and *Lacerta salamandra*. In Group II, Serpentes, Ramis included *Coluber natrix,* which we identify as the "viperine snake", *Natrix maura* (Pérez-Mellado 2005). It should be noted that one of the useful results of catalogues and faunistic lists of this first period is

FIGURE 1. Joan Ramis i Ramis (1746–1819), a lawyer, writer and archaeologist who published the first comprehensive list of amphibians and reptiles from Menorca Island in 1814.

the confirmation of the presence of several introduced species of amphibians and reptiles.

Second period: Scientific Exploration and Collections

We can consider that the first period ended and the second period began with the founding of the first cultural and scientific institutions that played an important role in the development of natural history research in the Balearic Islands. This is the case of Ateneu de Maó in Menorca, which housed a natural history museum where the first herpetological specimens were deposited. The Ateneu was the meeting point of local and foreign scientists, organizing conference cycles, exhibitions and different events. Thus, herpetological research in the Balearic Islands becomes linked to such institutions, usually with the collaboration of local naturalists, foreign scientists, as well as professional collectors.



SPECIMEN
ANIMALIUM, VEGETABILIUM, ET MINERALIUM
IN INSULA MINORICA FREQUENTIORUM
AD NORMAM LINNAEANI SISTEMATIS.
EXARATUM.
Accedunt nomina Vernacula in quantum fieri potuit.

SUPERIORIBUS ANNUENTIBUS.
MAGONE BALEARIUM
Excudebat Petrus Antonius Serra.
MDCCCXIV.

FIGURE 2. Title-page of the first "improved" edition of the *Catalogus* of Ramis I Ramis published in 1814.

As for other areas of the Mediterranean basin, the role of wealthy gentlemen and aristocrats of the Enlightment in the scientific exploration of the Balearic Islands was very important. Two individuals deserve immediate recognition, Lord Lilford (1833–1896) from England and the Archduke Luis Salvador (1847–1915) from Austria. The Archduke was a great traveller, explorer, and writer (Fig. 3). He is generally considered to be the first to show the unusual natural history value of the Balearic Islands to the rest of the European countries. His inclination to the natural sciences was, according to some biographers, the result of the Tuscan side of the Habsburg-Lorena House. He published several books describing islands and countries visited during his life. His first trip to the Balearic Islands, in 1867, was made while he was a student. He owned several properties in Mallorca Island and spent more time in the Balearics than in any other place. Thanks to the help of a close collaboration with local naturalists such as Francesc Cardona i Orfila from Menorca (Vidal Hernández 1997), he included observations on the natural history of the Balearic Islands in his publications (see A. Luis Salvador, *Die Balearen in Wort und Bild* [1869–1891]; also the 2000 edition for Menorca Island). Although his observations on amphibians and reptiles are limited, he did comment on melanistic lizards from Aire Island in Menorca, that he erroneously assigned to *Lacerta agilis*, as well as on terrestrial tortoises, terrapins, and snakes (Pérez-Mellado 2005). The Archduke's

FIGURE 3. The Archduke Luis Salvador (1847–1915), a great traveller, explorer and writer who made an important contribution to the knowledge of natural history of Balearic Islands.

scientific activity within the Balearic Islands influenced several European scientists and served as a basic reference and starting point for further studies (Vidal Hernández 2003).

Herpetological knowledge of the Balearic Islands received an additional boost with the visit of an ornithologist, Thomas Littleton Powys (Fig. 4), 4th Baron Lilford (18 March 1833–17 June 1896). Lilford spent several years at Oxford University but left without completing a degree. He was one of the eight founders of the British Ornithologists' Union in 1858 and its President from 1867 until his death. He travelled widely, especially in the Mediterranean region, making an extensive bird collection. His first travel was to Sicily, followed by a long trip with Hercules Rowley on a yachting cruise in the Mediterranean from 1856 to 1858. Between 1864 and 1882, he made several trips to Spain and other Mediterranean countries. In the course of these, he rediscovered the endangered Audouins' seagull, *Larus audouini*. He captured the first known Balearic lizards from Aire Island, south-eastern Menorca, in 1865. He donated some living specimens to the British Museum (Natural History) in London, that later were described and dedicated to him by Albert Günther as *Zootoca lilfordi* (Fig. 5) (the Lilford's wall lizard or Balearic lizard [*Podarcis lilfordi*]).

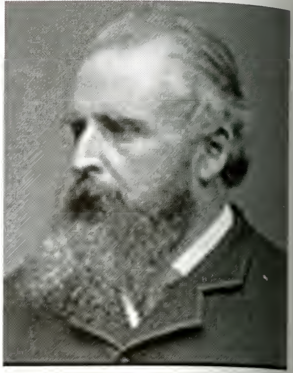


FIGURE 4. Thomas Littleton Powys, 4th Baron Lilford (1833–1896), discovered the Balearic lizard and collected the first specimens for the British Museum (Natural History) in London.

FIGURE 5. The Balearic lizard, *Podarcis lilfordi* from its type locality, Aire Island (Menorca).

Albert Karl Ludwig Gotthilf Günther (1830–1914) was a leading ichthyologist and herpetologist (Fig. 6) of the mid-19th century who spent most of his scientific career in London at the British Museum (Natural History). He was an early champion of the emerging field of zoogeography (Smith 2005). Born in Esslingen, Württemberg, Germany, Günther completed his M.D. degree at Tübingen. However, he scarcely had time to put his medical training into practice because in 1857 he was offered a place in the Zoology Department of the British Museum (Natural History) by John E. Gray, whom he succeeded as Keeper in 1875. Günther published more than 200 herpetological works. During his many years in England, he also had a close epistolary relation with Charles Darwin, who frequently cited Günther's observations on sexual dimorphism of lower vertebrates in his *Descent of Man* (Adler 1989). In fact, Günther provided so many observations to Darwin that Darwin acknowledged him in writing: "My essay, as far as fishes, batrachians, and reptiles are concerned, will be in fact yours, only written by me". Günther had a similar influence on Alfred Russell Wallace's magnum opus, *Geographical Distribution of Animals*, contributing basic information about the distribution and classification of amphibians and reptiles of the Galapagos and Mascarene Islands.

FIGURE 6. Albert Karl Ludwig Gotthilf Günther (1830–1914), in 1874 described the Balearic lizard, *Zootoca lilfordi* (now known as *Podarcis lilfordi*)

Among German-speaking herpetologists, one important figure of that time who worked with reptiles from the Balearic Islands was Jacques Vladimir von Bedriaga (1854–1906) (Fig. 7).

FIGURE 7. Jacques Vladimir von Bedriaga (1854–1906), a leading Russian herpetologist, studied the lacertid lizards from Balearic Islands; he placed them within the wall lizard, *Lacerta muralis*.

Bedriaga was born in Kriniz, Russia. He entered the University of Moscow in 1872, but left the following year because of health problems. He went to Germany and attended the University of Jena, where he made contact with several of the leaders of Darwinian revolution. For instance, his modern viewpoint in the descriptions of species and varieties was likely influenced by his professor, Ernst Haeckel (Böhme 1996), a strong supporter of evolutionary ideas. To improve his health, he moved to Nice and then to Florence, where he died in 1906 (Adler 1989). The Balearic lizard described by Günther in 1874 was the object of the description of three infraspecific taxa by Bedriaga (1879) in a work of a wider scope. Later, Bedriaga considered the species a synonym of *Lacerta muralis* (Bedriaga 1886), as he did several other supposedly good species described from the Mediterranean basin. Thus, Bedriaga (1886) recognized the subspecies *Lacerta muralis balearica* with three varieties: *lilfordi* Günther, *gigliolii* Bedriaga (Fig. 8) and *pityusensis* Boscá. In this sense, he can be included in the group of "lumpers", those specialists who try to produce a classification in which the emphasis is placed on relationships, avoiding fine division of taxa (Mayr and Ashlock 1991, also see below). Interestingly, Bedriaga (1886) cited *L. muralis balearica* from islets of Rey and Colom, as well as from the main part of Menorca Island. We do not know if it was a collecting error, or whether, at that time, the Balearic lizard was still present on Menorca Island, but it is not to be found there now.

FIGURE 8. Bedriaga described this variety as *Lacerta muralis balearica* var. *gigliolii* (now *Podarcis lilfordi gigliolii*) from Dragonera Island (Mallorca).

During these years, Maximiliam Gustav Christian Braun (1850–1930) published observations on the Balearic lizards from Menorca, correctly ranking "*lilfordi*" as a full species within the genus *Lacerta* (Braun 1877). Braun maintained an intense epistolary relationship with the great Minorcan naturalist, Joan J. Rodríguez Femenias (1839–1905). Braun was a botanist (Fig. 9) but with a wide range of scientific interests. Rodríguez Femenias sent herpetological material to Braun as well as other scientists of his time, including Bedriaga. Indeed, some lizards collected by Rodriguez Femenias were not studied until examined by Martin Eisentraut in the late 1920s (Eisentraut 1928b). It was during a visit in the spring and summer of 1882 to Menorca (Vidal Hernández 1995) that Braun made the first observations on the ecology and behavior of the Balearic lizard on the coastal islets of Rey and Aire.

Few Spanish scientists took an interest in the Balearic herpetofauna during this period. Martínez y Sáez (1875) was a brilliant entomologist who had also published several notes on herpetology. He was professor of Zoology at Madrid University and keeper of collections at the National Museum of Natural Sciences (Gómez and Sanchíz 1987). Martínez y Sáez described a small collection sent by Francesc Cardona from Menorca (see above regarding the relationship of Cardona and the Archduke Luis Salvador), from which we can extract the first record of the false smooth snake, *Macroprotodon mauritanicus* (mentioned as *Psammophylax cucullatus*), as well as some records of the viperine snake, *Natrix maura* (as *Tropidonotus viperinus*), the European pond

terrapin, *Emys orbicularis* (as *Emys lutaria*), the Moorish gecko, *Tarentola mauritanica*, the common tree frog, *Hyla arborea*, the green toad, *Bufo viridis*, the Balearic lizard, *Podarcis lilfordi* (as *Zootoca muralis*) and *Coronella quadrilineata* that corresponds to Ladder snake, *Rhinechis scalaris* (Alonso-Zarazaga 1998). This paper gave an almost complete list of the Menorca herpetofauna (with the exception of the Hermann's tortoise, *Testudo hermanni*). In addition, Martínez y Sáez (1875) mentioned some very interesting observations of Francesc Cardona that detected the presence of Balearic lizards only in coastal islets around Menorca. Hence, here we can have a first confirmation of the extinction of this species from the main island of Menorca. Francesc Cardona i Orfila (1833–1892) was a priest and naturalist from Menorca who had an intense scientific activity as malacologist and entomologist, with some contributions to geology and palaeontology. He assembled an extraordinary collection of shells, usually considered the second most important collection of its kind in Spain (Vidal Hernández 2003).

FIGURE 9. Joan J. Rodríguez Femenias (1839–1905, in the centre of picture), an excellent naturalist from Menorca who for many years maintained an epistolary relation with some of Europe's leading herpetologists and supplied them with herpetological material.

Rodriguez Femenias, in his own work on Menorcan natural history (Rodríguez Femenias 1887), presents the same list of amphibians and reptiles published by Martínez y Sáez in 1875. A similar list, with some comments rejecting traditional legends for some species, was also published by Oleo i Quadrado (1876) in his *Historia de Menorca*. And, in that same year, Barceló i Combis published a list of the Balearic herpetofauna that, in fact, is the first account for the whole archipelago.

Francesc Barceló i Combis (1820–1889) (Fig. 10) was a medical doctor and teacher of physics, chemistry, and natural sciences at the High School Institut Balear (Jurado 2006) on Mallorca Island. In 1876, he recorded for the first time in the Balearic Islands the Iberian water frog, *Rana perezi* (as *Rana escubente* L. [*sic*]), as well as many other species. It is also noteworthy that Barceló recorded the introduction of the Spanish terrapin, *Mauremys leprosa* (as *Terrapene leprosa*) from Algeria onto the Balearics.

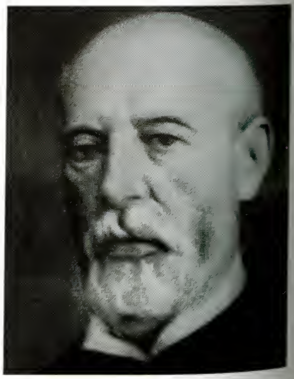


FIGURE 10. Francesc Barceló i Combis (1820–1889) published the first list of amphibians and reptiles for the Balearic Islands.

During these years, the activity of European herpetologists continued, not only with visits to the archipelago, but also with the study of museum specimens. In this way, Oskar Boettger (1844–1910) described a new subspecies of the green toad, *Bufo viridis balearica* (Boettger 1880), from Mallorca and Menorca and confirmed its presence on Ibiza Island (Boettger 1881). Boettger was also one of the leading herpetologists of his time and was responsible for establishing the Senckenberg Museum in Frankfurt am Main as a world centre for herpetology (Adler 1989).

Without doubt, the leading figure of Spanish herpetology during 19th century was Eduardo Boscá i Casanoves (1844–1924), a biologist and medical doctor born in Valencia (Fig. 11). He started his career as a teacher in a high school but then moved to Valencia University as professor of natural history. Boscá made extensive collections in several areas of the Iberian Peninsula. He also traveled to the Balearic Islands making one of the first Spanish contributions to the herpetological knowledge of the archipelago. His most important herpetological work was the first catalogue of Spanish amphibians and reptiles (Boscá 1877). This was greatly improved in two subsequent revised editions (Boscá 1880, 1881). Boscá was deeply influenced by Ferdinand de Lataste, a leading French herpetologist. Lataste helped him with more difficult systematic tasks during the description of new taxa (Fraga 1989), including the endemic lacertid lizard from Pityusic Islands, *Lacerta muralis* var. *pityusensis* (Fig. 12), described in one of Boscá's last herpetological works published after he visited Ibiza Island (Boscá 1883). Earlier Boscá (1877) recorded several species for the Balearic Islands in his catalogue, including the spur-thighed tortoise, *Testudo graeca*, which he recognized as an introduced species.

FIGURE 11. Eduardo Boscá i Casanoves (1844–1924), a leading Spanish herpetologist, published the first catalogue of amphibians and reptiles of Spain in which he included observations on the Balearic herpetofauna.

As with the works of other 19th century Spanish zoologists, in the works of Eduardo Boscá we can distinguish two distinct periods. Boscá's first version of the catalogue of Spanish amphibians and reptiles (Boscá 1877) is somewhat old-fashioned, i.e., of the "classical school" work (Fraga 1989), as are those of Barceló i Combis or Pérez Arcas. But, after 1877, Boscá's works take on a more modern tone, thanks to increasingly frequent contacts with other European specialists, and he began to express views reflecting newly emerging ideas in zoogeography, ecology, and evolution. Indeed, during this second period of his scientific career, Boscá became a confirmed evolutionist, so much so that he participated in and presented a lecture (read by another person, because he was ill the day of the presentation) at a celebration held in Valencia to pay homage to Darwin on the occasion of the centennial of Darwin's birth in 1909. In Spain, this event served to confirm Darwinism as the main evolutionary theory (Glick 1982). Thus, under the influence of Darwinian ideas, Boscá's herpetological works include, for the first time in Spanish scientific literature, ecological, biogeographical, and embryological observations (Sánchez Arteaga 2005). Special attention was given to variability within species, and varieties were widely treated in systematic revisions (Fraga 1989). For example, in his work on the Ibiza herpetofauna (Boscá 1883), Boscá made interesting comments about the "...problems of adaptation and other life factors", from a clearly evolutionary position. Although Boscá (1883) recorded, erroneously, the Balearic lizard from the town of Ibiza, he did clearly distinguish it from the "variety" he described as *Lacerta muralis* var. *pityusensis*. His description of the Ibiza wall lizard was quite precise. He also presents a short list of coastal islets where the variety is present as well as observations of individuals with clipped toes. Also in his Ibiza paper, he comments about

FIGURE 12. Boscá described the Ibiza's wall lizard as *Lacerta muralis* var. *pityusensis*.

the scarcity of the Balearic lizard on Mallorca. Lastly, it is noteworthy that Boscá was the first to record what he thought to be *Alytes obstetricans* on Mallorca Island (Boscá 1881). He had observed only tadpoles. Later it would be as a new species, endemic to the Balearic Islands, the Majorcan midwife toad, *Alytes muletensis* (see below).

Balearic amphibians and reptiles also received the attention of herpetologists from Catalunya such as Joaquim Maluquer i Nicolau (1892–1986) who published three papers dealing with the distribution of Balearic species (Maluquer 1917, 1918 and 1919).

Almost 50 years after the visit of Braun to Menorca, the Balearic lizard again drew the attention of German herpetologists, especially Lorenz Müller (Fig. 13), who described several subspecies (Müller 1927a and b, 1928a, b, c and d), and Martin Eisentraut, who recognized additional subspecies, even if earlier they had been included as synonyms of previous taxa (Eisentraut 1928a and b). Lorenz Müller (1869–1953) was one of the most important European herpetologists of his time and the mentor of Robert Mertens, who would become the one of the world's leading herpetologists of the mid-20th century. Müller described several subspecies of lizards from the Balearic Islands, competing in this task with Martin Eisentraut (Eisentraut 1928a and b; Müller 1927a and b, 1928a, b, c and d). To gain the priority over Müller in the naming of new taxa, Eisentraut published several of his early descriptions in weekly amateur magazines (Böhme 2004); but, as a matter of fact, Müller did too! Martin Eisentraut (1902–1994) had a wide range of scientific interests, from bats, marsupials, and rodents to insects, birds, ascidians, and reptiles (Fig. 14). He mainly worked with the African and South American fauna. During his productive scientific life, he published about 240 papers and books of which his research on Balearic lizards included seven systematic papers, one book, and two additional papers on insular melanism (Böhme and Hutterer 1999). Hence, his research on Balearic Islands can be considered a "lizard *intermezzo*" (Böhme 2005). Rarely has so short an *intermezzo* produced so excellent results! Eisentraut described in a short period 18 subspecies of *Podarcis lilfordi* (Fig. 15) and *Podarcis pityusensis* (Fig. 16; Eisentraut 1928a and b, 1929, 1930). The most interesting point is that he himself travelled to the Balearic Islands, where he made extensive collections, including sampling populations on many of the islets. He kept careful field notes in which he recorded the life colors of the lizards as well as observations on their behavior and ecology. Noteworthy is that these observations are scarcely mentioning his first systematic works. A second *intermezzo* devoted to the study of tropical areas took place following this period and up to 1949, when he would again rethink his ideas about insular lizards (see below).

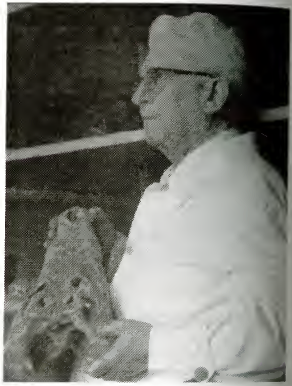


FIGURE 13. Lorenz Müller (1869–1953) described several subspecies of both endemic lizards from Balearic Islands.

FIGURE 14. Martin Eisentraut (1902–1994) was one of the most important herpetologists who worked in Balearic Islands. He described several subspecies of *Podarcis lilfordi* and *Podarcis pityusensis* and made important contributions to our understanding of the factors that influence the evolution of lizards in insular environments.

Although other German herpetologists contributed to the description of the outstanding variability of Balearic lizards, we mention here only Otto Wettstein von Westersheimb (1892–1967), who described two subspecies, *Lacerta pityusensis algae* and *Lacerta lilfordi hartmanni* (Wettstein 1937).

At the end of this second period, only a few short contributions

from local naturalists dealt with amphibians and reptiles. Castaños (1930) gave us one of the very few descriptions of the most differentiated Balearic lizard subspecies, *Podarcis lilfordi rodriquezi* from Ratas islet, within the Port of Maó (Menorca). The islet was destroyed five years later to allow for the enlargement of the port (Fig. 17).

Third Period: Modern Research

We can start the third period of herpetological research of the Balearic Islands with the leading taxonomic herpetologist of his era, George A. Boulenger (1858–1937). Born in Brussels, Belgium (Fig. 18), he was appointed Assistant Naturalist at the Musée Royal d'Histoire Naturelle de Belgique. Albert Günther hired him as assistant in charge of lower vertebrates at the British Museum (Natural History) in London. During his lifetime, Boulenger published more than 900 scientific papers and books (Adler 1989). He had a great influence on European herpetology, in the case of lizards with the publication of his monumental *Catalogue of the Lizards in the British Museum (Natural History)* in three volumes (Boulenger 1887) and later with his monograph of the Lacertidae (Boulenger 1920). Boulenger was clearly a "lumper", combining within the genus *Lacerta* the genera *Lacerta, Gallotia, Zootoca*, and *Podarcis*. In this way, he recognized 23 varieties within *Lacerta muralis*, including the whole set of known Mediterranean species. From his viewpoint, *Lacerta muralis* shows the highest polymorphism within Reptilia (Boulenger 1920). He also studied living specimens from Aire Island (Menorca) sent to him by Jaume Ferrer Aledo (1856–1956), a Minorcan ichthyologist.

During the second half of the 20th century, interest in the herpetological fauna of the Balearic Islands by Europeans declined. Karl F. Buchholz (Fig. 19; 1911-1967) described *Hemidactylus turcicus spinalis*, a subspecies of the Turkish gecko, from Addaia Gran Islet (Fig. 20), Menorca (Buchholz 1954). Buchholz

Figure 15. *Podarcis lilfordi fenni* from Sanitja Islet (Menorca) was one of the subspecies of the Balearic lizard described by Martin Eisentraut.

Figure 16. Eisentraut described, among other subspecies, *Podarcis pityusensis negrae* from Ses Illetes Negres, close to Ibiza harbour.

Figure 17. Ratas Islet, within the port of Maó (Menorca). On this small islet lived *Podarcis lilfordi rodriquezi*, the most differentiated subspecies of the Balearic lizard. The islet was destroyed in 1935.

actively participated in the discussion of the evolutionary process of the Balearic lizards entertained by Martin Eisentraut and Max Hartmann (Fig. 21). Letters conserved at Zoologisches Forschungsinstitut of Bonn reveal the strong criticisms of Buchholz and Max Hartmann (1876–1962) of the supposedly Lamarckian explanations proffered by Eisentraut in his early papers, but which were abandoned in his later works (Eisentraut 1949, 1950 and 1954). Buchholz (1954) also described eight new subspecies of *Podarcis pityusensis* from material collected by Hermann Grün and Walter Jokisch (Böhme 2004). Max Hartmann, a geneticist, described two subspecies, *Lacerta lilfordi toronis* and *Lacerta pityusensis isletasi* (Hartmann 1953). Dieter Lilge published the first systematic revision of the subspecies of *Podarcis pityusensis*, employing biometrical techniques in his character analyses (Lilge 1975). Amphibians were also studied by European herpetologists. For instance, Helmuth Hemmer confirmed the specific status of the Iberian water frog, *Rana perezi*, for the Balearic Islands (Hemmer and Kadel 1980).

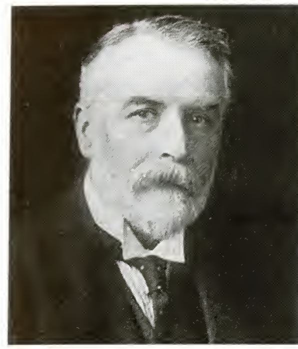


FIGURE 18. George A. Boulenger (1858–1937), one of Europe's leading herpetologists. He studied Mediterranean lizards, including those from the Balearic Islands. He classified all of the subspecies of the two Balearic species as varieties of *Lacerta muralis*.

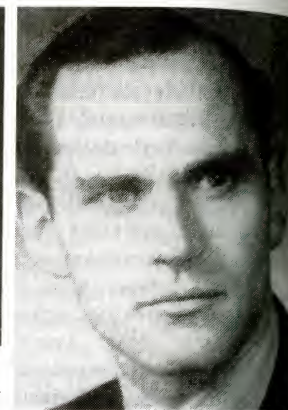


FIGURE 19. Karl F. Buchholz (1911–1967) described the only known subspecies of a gecko from the Balearics, *Hemidactylus turcicus spinalis*, from Addaia gran Islet (Menorca).

The most important German-speaking (though Russian by birth) herpetologist of the period was Robert Mertens (1894–1975), who has had a sustained influence on Mediterranean herpetology (Böhme 2004). Mertens (Fig. 22) was born in St. Petersburg, Russia and completed a Ph.D. dissertation at Leipzig University on lacertid lizards from Italy. Like Boulenger before him, Mertens was extraordinarily productive, publishing nearly 800 titles during his lifetime. Among these are several contributions to the study of insular herpetology in which the Balearic amphibians and reptiles are discussed in whole or in part (Mertens 1921, 1924, 1927, 1929, 1934, 1957, 1958). Mertens and Müller (1928, 1940)

FIGURE 20. Addaia gran islet (Menorca), the type locality of *H. turcicus spinalis*.

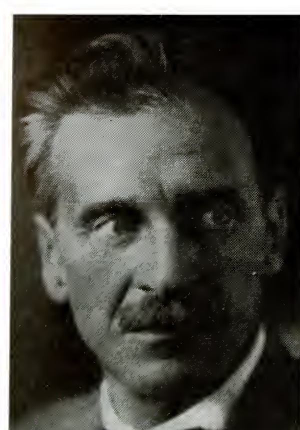


FIGURE 21. Max Hartmann (1876–1962), a geneticist, described two subspecies of lizards from the Balearics. He actively participated in discussions with Eisentraut and Buchholz about the origin of melanism in insular populations of lizards.

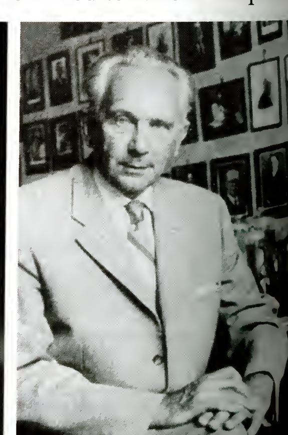


FIGURE 22. Robert Mertens (1894–1975) was the leading German herpetologist of the mid-20th century. He published several contributions to the knowledge of the Balearic herpetofauna. In the last edition of his catalogue of European reptiles and amphibians, he treated both endemic lizards as full species.

and Mertens and Wermuth (1960) collaborated on several catalogues of the European herpetofauna in which they include information about the amphibians and reptiles of the Balearics. In fact, the catalogue from Mertens and Wermuth (1960) can be considered the starting point of a modern systematic approach to the European and, by extension, the Balearic herpetofauna. In this work, both authors finally recognized the full specific status of the two endemic lacertid lizards from the Balearics and proposed a synthetic arrangement of subspecies that Salvador (1974) fully followed in his Spanish catalogue. Heinz Wermuth also described the subspecies *Testudo hermanni robertmertensi* (Wermuth 1952), which for many years was thought to be the form present in the Balearic Islands. But Bour (1987) showed that the subspecies present in the Balearics is *T. hermanni hermanni*. Additional contributions dealin with the terrestrial tortoises and pond terrapins were published by Raxworthy (1984) and Vickers (1983).

FIGURE 23. Eisentraut (1950) gave a large amount of information on the natural history, ecology and behaviour of Balearic lizards, including excellent drawings with coloration of living specimens.

Even though it was published in 1929, the paper by Martin Eisentraut about the variation of insular lizards must be included within this third period of modern research because Eisentraut (1929) addressed a modern topic with an original vision of the problem. Eisentraut studied the chromatic variation of Balearic lizards and the rise of melanistic populations, observing more than 1200 living lizards from almost 50 different populations (Fig. 23). He advanced a rather confusing hypothesis concerning the rise of melanism that was quickly interpreted as a Lamarckian explanation by Buchholz and Hartmann. Then, after a period of almost 30 years devoted to tropical faunas of different groups of vertebrates, Eisentraut returned again to think about insular lizard and evolution. He clarified his position regarding how, from his viewpoint, melanism appeared, and he stressed the important contribution of herbivorous diet in the origin of melanistic populations (Eisentraut 1950, 1954). But he also accepted some of the criticisms made by Hartmann (1953), so that he now allowed for a neutral value for melanism among insular lizards. This then led him to reexamine the question of the origin of herbivory on islands and its effect on intestinal length, a topic he had taken up in his 1929 paper (see above). Others who participated in these discussions were Karl Buchholz and Robert Mertens (Böhme 2004).

Eisentraut was the pioneer of some of the more interesting topics of insular evolution of lizard populations. The distinguished Harvard evolutionary biologist, Ernst Mayr, recognized this fact in his seminal book *Animal Species and Evolution* (Mayr 1963), in which in four different places he cites the studies of Eisentraut and other herpetologists in the Mediterranean Basin to illustrate the origin of morphological traits such as melanism, as well as the extraordinary variability among populations and the appearance of characters related to the relaxation of predation pressure.

The so-called "Silver Age" of Spanish science and culture, during the last years of the 19th century and the first third of the 20th century (Otero 2001), was a time of extraordinary productivity, but it failed to have any significant influence on herpetological studies. In the late 1930s, and throughout the period of the Franco dictatorship, Spain suffered through a dismal period of low scientific output. Few studies were undertaken in the Balearic Islands, and only a few researchers published short accounts on the amphibians and reptiles. Due to the strong influence of the Catholic religion and conservative ideology, which were pervasive during the more than 40 years of Franco's rule, and for other sociological reasons, classical dispersal biogeography and Linnaean taxonomy coexisted with modern evolutionary approaches to explain the composition of the Balearic herpetofauna.

Guillem Colom Casasnovas (1900–1993) represents the classical naturalist trying to explain faunal composition of the Balearics strictly in terms of traditional dispersal biogeography. Colom (Fig. 24), a geologist and palaeontologist specializing on Foraminifera and other groups of microfossils, sought to explore other natural history fields as well. He published more than 200 scientific works during his professional career, which spanned 68 years, mostly on the Balearic Islands (Usera and Alberola 2005).

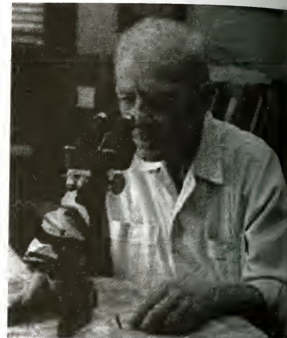


FIGURE 24. Guillem Colom Casanovas (1900–1993) was a palaeontologist and geologist who published several papers on the biogeography of the Balearic Islands, maintaining controversial opinions about the origin of amphibians and reptiles of the archipelago.

He published a few papers devoted to amphibians and reptiles (Colom 1951, 1952 and 1953) and later summarized his ideas on the biogeography of amphibians and reptiles in three general works (Colom 1957, 1978, 1988). The nomenclature employed by Colom, even in the books published in 1978 and 1988, was out of date; indeed, in some cases he used scientific names from the 19th century. Nevertheless, he correctly interpreted the North African origin for the false smooth snake, *Macroprotodon mauritanicus* (Fig. 25). Colom also thought that the origin of the Balearic lizard could be traced to a stock of *Lacerta muralis* that entered the islands thanks to a connection between them and the Iberian Peninsula at the end of the Pliocene (Colom 1978).

Colom's position regarding the systematic status of the Balearic lizard is confusing. On the one hand, he accepted Boulenger's (1920) treatment that included all wall lizards of the western Mediterranean within *Lacerta muralis*, but on the other, he wrote about the slow speciation process in the Balearics and recognized the existence of several "vicariant races" within the archipelago. His use of the genus *Lacerta* to classify the small wall lizards is not surprising, even in 1978, and even coming as it did five years after publication of Edwin N. Arnold's seminal paper resurrecting the genus *Podarcis* (Arnold 1973). What is surprising is Colom's propensity to consider both endemic species of Balearic lizards as mere varieties of *Lacerta muralis* (Colom 1978). Another surprising point is his detailed presentation of the distribution of *Podarcis lilfordi* on Mallorca Island, where he considered that the species to be present along a narrow strip of south-west-

FIGURE 25. Guillem Colom correctly concluded that the false smooth snake, *Macroprotodon mauritanicus* was a species introduced from North Africa.


FIGURE 26. The Italian wall lizard, *Podarcis sicula*, introduced onto Menorca Island.

ern, south and south-eastern coasts (Colom 1978). All indications from other authors confirmed that the species was completely extinct on both Mallorca and Menorca islands, probably dating back to Roman times (Sanders 1984).

Colom's position is also unsound with respect to the Italian wall lizard, *Podarcis sicula* (Fig. 26), which he considered a relict of the Tyrrhenian fauna, and clear proof of a land connection of Balearics and the rest of the so-called Tyrrhenian massif. The opinion of all other herpetologists is that the Italian wall lizard is an introduced species in Menorca. Defending his position, Colom (1978) also suggested that *P.sicula* is really scarce in Menorca and close to extinction because of its lower "vitality" compared to the Balearic lizard. In fact, the situation in Menorca is exactly the opposite; the Italian wall lizard is abundant whereas *P. lilfordi* is absent from the main island. In addition, Colom (1978) also proposed that the Balearic populations of *Testudo graeca* and *Rana perezi* were derived from the Iberian Peninsula and *T. hermanni, Bufo viridis* and *Hyla meridionalis* from the Tyrrhenian massif.

The case of Guillem Colom is, from our viewpoint, interesting because it represents a clear example of a non-specialist in herpetology disregarding the preponderance of herpetological knowledge of his time. Even more, it is surprising that his biogeographical hypothesis, being that of a palaeontologist, did not take into account the complete absence of a Balearic fossil record for all present-day species of amphibians and reptiles, excepting the three endemics, *P. lilfordi, P. pityusensis* and *A. muletensis*.

During this period of low scientific activity in Spain, only three or four researchers dealt with the Balearic amphibians and reptiles. One of them was Arturo Compte Sart, an entomologist from the National Museum of Natural History in Madrid, who made an expedition in 1965 to Ibiza Island (Compte 1966) and who had previously collected data from the remaining Balearics across a period spanning at least ten years (Compte 1977, 1968). Compte (1966) recorded six species of amphibians and reptiles from Ibiza. In his paper, Compte talked about doubtful records for the spiny-footed lizard, *Acanthodactyus erythrurus,* from Ibiza (Colom 1957) and the presence of two terrestrial tortoises, *Testudo hermanni* and *T. graeca,* at Ibiza and Formentera islands. At that time, it was widely accepted that the spur-thighed tortoise was introduced to the Balearic Islands, whereas Hermann's tortoise was, erroneously, considered an autochthonous species. From an historical viewpoint, the work of Compte (1966) is the first to confirm the extinction of *Testudo hermanni* on Ibiza Island.

Another noteworthy is Antonio Vidal, a specialist of freshwater fauna, who studied Balearic amphibians and presented his work in two publications (Vidal 1965, 1966). This author, not only produced a faunistic work, but he also included observations on breeding biology and phenology of Balearic anurans.

Between 1950 and 1974, Juan Pablo Martínez-Rica, a researcher at the Instituto Pirenaico de Ecología (CSIC, National Council of Research), visited the Islands to study the herpetofauna, occasionally accompanied by Enrique Balcells (Balcells 1955; Martínez-Rica 1965a and b, 1967a and b). Martínez-Rica studies resulted in a Ph.D. dissertation on the natural history and ecology of geckonid lizards (Martínez-Rica 1974).

Somewhat earlier, Balcells (1955) had recorded the presence of lacertid lizards at the ancient

walls of Palma de Mallorca, assigning them, erroneously, to *Podarcis lilfordi* (they were actually an introduced population of *Podarcis pityusensis* from Ibiza).

In the late 1960s, and overlapping the period of Martínez-Rica, the situation began to change drastically with the arrival of a new group of young Spanish researchers. The most important of these younger entrants was and still is Alfredo Salvador Milla, an active researcher at the CSIC (National Research Council) at the National Museum of Natural History, Madrid. Alfredo Salvador completed his M.D. thesis on the feeding ecology of the Balearic lizard from the Cabrera Archipelago (Salvador 1976a) thus initiating a fruitful period of research in the Balearic Islands. He produced a systematic revision of the subspecies of *Podarcis lilfordi* the from Cabrera Archipelago and Mallorca islets, coauthored a systematic revision of *Podarcis lilfordi* from Menorca islets (Pérez-Mellado and Salvador 1988), and studied many other aspects of the Balearic herpetofauna, the results of which he presented in a series of papers collectively titled *Herpetofauna balearica* (Salvador 1976b, 1978, 1979a and b, 1980a and b). For the seminal *Handbuch der Reptilen und Amphibien Europas,* edited by Wolfgang Böhme, Salvador contributed the chapters dealing with the two endemic Balearic lacertid lizards as well as a number of Iberian species (Salvador 1986a and b). He published a revision of the *Podarcis pityusensis* species group in 1984, earlier a study on its thermal biology (Pérez-Mellado and Salvador 1981), and, lastly, a general account of the Ibiza's herpetofauna (Salvador and Pérez-Mellado 1984).

Activity in the Balearic Islands during the second half of 20th Century involved also resident scientists such as Josep Antoni Alcover, Joan Mayol, Miquel Palmer, Guillem X. Pons and Antonia María Cirer, Encarna Sáez, and Núria Riera. Alcover is a palaeontologist, Mayol an ornithologist and conservationist, and Palmer an entomologist. But each of them is also interested in living vertebrates and all have published short papers and monographs on the origin, diversity, and biogeography of Balearic amphibians and reptiles (e.g., Alcover 2000; Alcover and Gosálvez 1988; Alcover and Mayol 1981, 1982; Pons and Palmer 1996; Palmer et al. 1999). Alcover and Mayol were also involved in the rediscovery of the Majorcan midwife toad (Alcover and Mayol 1980; Alcover et al. 1981; Mayol and Alcover 1981; Hemmer and Alcover 1984). In 1981, Alcover et al. published an updated account of the fossil record of amphibians and reptiles of Balearic Islands that provides essential information needed to understand the history of the present-day faunistic composition of the archipelago. Joan Mayol studied different aspects on the distribution, conservation, and natural history of the Balearic herpetofauna and published two editions of a well-known field guide for these islands (Mayol 1981; Mayol 1985, 1992, 2003; Mayol et al. 1988). Antonia María Cirer did her M.D. thesis (Cirer 1981, 1982) and her Ph.D. dissertation on the systematics of *Podarcis pityusensis* (Cirer 1987a). She published several other related papers (Cirer 1987b, 1987c, 1988; Cirer and Guillaume 1986; Cirer and Martínez-Rica 1986, 1990) concluding that only seven subspecies of the Ibiza wall lizard can be recognized.

Today, flooded by the new discoveries of molecular systematics, it is clear that the description of a new vertebrate species is a frequent event. But during last fifty years, the European fauna of amphibians and reptiles was thought to be mostly described and novelties were rare. In the synthetic atmosphere constructed by George A. Boulenger, the discovery of a new amphibian or reptile species within European boundaries was an extraordinary event. Such was the case of the midwife toad, *Alytes muletensis,* from Mallorca. Larvae of this species were previously detected by Eduardo Boscá during the 19th century and assigned to the continental midwife toad, *Alytes obstetricans* (Boscá 1881 and see above). Then, the sceptical 20th century herpetologists rejected this record and left this species unstudied for almost one hundred years, considering the observation of Boscá an identification mistake. Sanchíz and Adrover (1977) described a new fossil species of anuran from an archaeological site, the cave of Sa Muleta on Mallorca Island. They named the species

Baleaphryne muletensis, the Balearic toad from Sa Muleta, and dated the fossil from the Middle and Upper Pleistocene. Sanchíz and Adrover (1977) described the differences between the new genus and the closest genus *Alytes*. In 1980, a team of speleologists and biologists rediscovered the species living in an almost inaccessible habitat in north-western Mallorca (Fig. 27). Immediately, an international team of researchers undertook the task of studying this relic population of the Majorcan midwife toad, comparing it with Iberian species of the genus *Alytes*, with which the living fossil was classified (Hemmer and Alcover, 1984). The study of this endangered and extremely interesting species continues today with the participation of research teams from different countries (see, for example, Buley and García, 1997; Kraaijeveld et al. 2003 or Kraaijeveld et al. 2005).

Endemic Balaeric Island species were not the only animals studied during the past two centuries. All of the Balearic herpetofauna attracted attention, especially of herpetologists. Authors, like Martin Eisentraut, would recognize that most of the amphibians and reptiles inhabiting the Balearics were introduced by humans during historic times. But, because the Balaerics have a para-oceanic origin, and because most of the species appear to have been introduced, intentionally or not, by human intervention, current postulates of island biogeography theory cannot be applied directly to explain the faunal composition.

Thus, more recently, herpetologists have turned their attention to archaeology and history to understand first the events of human colonization. To explain the arrival of some species, it is necessary to uncover the existence of shipping lanes that linked, for example, the Balearic Islands with North Africa that could help account for the arrival of the Moroccan rock lizard, *Lacerta perspicillata* or the false smooth Snake, *Macroprotodon mauritanicus*. Their occurrence in Menorca, but not in Mallorca and Ibiza, must have been a result of the fact that those last two islands lay outside of the commercial routes of ships coming from North Africa, that stopped at Menorca enroute, in some instances, to ports in southern France or elsewhere along the southern European coast. Moreover, the explanation of the widespread presence of the European pond terrapin, *Emys orbicularis*, in Menorca and Mallorca, does not need abstruse biogeographical hypotheses, but the knowledge of different religious rules, culinary traditions or practical uses. For example, pond terrapins were eaten during Lent, when meat is forbidden for Catholics, because pond turtles were considered fish. Also well known is the use of fat from terrapins as excellent oil for textile mills and other machines in Menorca during 18th and 19th centuries (Archduke Luis Salvador, 1890 *in* Braitmayer et al. 1998; Fritz et al. 1998). The most recent molecular studies for the false smooth snake as well as for the Moroccan rock lizard and European pond turtle (Fritz et al. 1998) confirm this recent introduction. The population of *Emys orbicularis* from Menorca was also studied by Klaus Methner who proposed the existence of a dwarf population in some localities of Menorca (Methner 1980, 1988).

Conclusions

The herpetological exploration of the Balearic Islands focused on the study of two very different groups of species. A large set of introduced amphibians and reptiles came from several sources and probably always with human help. The explanation of these introductions links frequently with history and archaeology and has less to do with insular biogeography and colonization of oceanic islands (Corti et al. 2000). On the other hand, the Balearic Islands are the home of only three endemic species of terrestrial vertebrates, the Majorcan midwife toad, the Ibiza wall lizard and the Balearic lizard. These three species were discovered during the 19th century, but their scientific study began during the 20th century with the pioneering works of Lorenz Müller, Martín Eisentraut, and Eduardo Boscá.

Why did European eminent herpetologists such as Bedriaga and Boulenger not recognize the

variety of insular lizards from the Balearic Islands and other insular areas of the Mediterranean basin as full species? In his book on systematic zoology, Mayr (1969) divided the history of theories of classification into six periods. According to Mayr (1969), the fifth period of "population systematics" did not begin until the 1920s. Thus, before that time, and for practical reasons, taxonomists treated species in a typological manner, as invariant units, and this long after the invalidity of the typological species concept was apparent, and long after the general acceptance of evolutionary theory. But, at the same time, the comparison of population samples from different geographical areas within the distribution range of a supposed single species, showed smaller or greater differences. The solution to this problem was the replacement of the typologically defined species by the polytopic species with several populations (Mayr 1969).

In the case of Mediterranean lizards, this influenced the taxonomic attitude of European herpetologists, who accepted the existence of a few polytypic species, as *Lacerta muralis* (*sensu* Boulenger 1920), with several highly differentiated populations within a very large distribution range. Hence, although the "new systematics" (Huxley 1940) led to a reevaluation of the species concept and to a more biological approach in taxonomy (Mayr 1969), at the same time it hampered the recognition of full species *status* for several populations of lacertid lizards within the Mediterranean Basin.

As we see in works of Bedriaga (1886), Boulenger (1920) and many of those active during the early years of the 20th century, such as Mertens (1925), the influence of these evolutionary ideas had a direct and interesting effect on the systematic arrangement of the extreme variability of Mediterranean amphibians and reptiles, and a good example can be extracted from Balearic lacertid lizards. These authors were conscious of the morphological variability of insular populations but, deeply influenced by the difficulties of defining a "good species" under new perspectives of evolutionary theory (see, for example, Dennett 1999), they turned to a lumping position, recognizing only a myriad of varieties within a reduced number of subspecies within very large species, like *Lacerta muralis*. In Europe, the situation began to improve in the mid-20th century, mainly with the publication of the European list of Mertens and Wermuth (1960). By then, leading European herpetologists turned again to recognize as full species the endemic populations of Mediterranean islands, including the two species from the Balearic Islands. The concept of variety was then abandoned, at least in vertebrate zoology, and the present-day taxonomical arrangement took shape.

Paradoxically, the influence of evolutionary ideas that obscured a more current systematic interpretation of insular variability helped the same herpetologists to recognize the evolutionary significance of this morphological variability and the need to include in their studies non-morphological elements from natural history, ecology, behavior, and development of these populations. In this way, Martin Eisentraut and, to a lesser extent, other authors like Max Hartmann and Robert Mertens, described, from a modern viewpoint, the ecological adaptations of insular lizards, trying for the first time to interpret some morphological adaptations like melanism, as well as ecological traits such as omnivory and population densities (Eisentraut 1950, 1954). The route of actual studies on behavioral ecology of insular lizards was opened. This route would not have been posssible to follow were it not for the insights in the pioneering works of Eisentraut, Braun, Boscá, Müller, Hartmann or Mertens.

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about the life and works of Martin Eisentraut and, in general, the key role played by German researchers in the herpetological studies of the Balearic Islands. During our visits to the Alexander Koenig Museum and its excellent herpetological collection, we were able to examine the letters and documents from scientists and collectors that were extremely useful. Lastly, we greatly appreciate the thoughtful comments by Terry Gosliner on an early draft of the manuscript.

References

ADLER, K. 1989. Herpetologists of the Past. Pages 5–141 *in* K. Adler, ed., *Contributions to the History of Herpetology*. Contributions to Herpetology 5. Society for the Study of Amphibians and Reptiles, Oxford, Ohio, USA.

ALCOVER, J.A. 2000. Vertebrate Evolution and Extinction on Western and Central Mediterranean Islands. *Tropics* 10(1):103–123.

ALCOVER, J.A., AND J. GOSÁLVEZ. 1988. Los vertebrados terrestres de las Islas Baleares y Pitiusas: una aproximación biogeográfica. Pages 153–158 *in* C.P. Blanc and J.N. L'Héritier, eds., *Actes du Colloque International sur les Vertébrés terréstres et dulcéaquicoles des îles méditérranées.* Bulletin d'Écologie 19(2–3). Evissa, Corse, France.

ALCOVER, J.A., AND J. MAYOL. 1980. Noticia del hallazgo de *Baleaphryne* (Amphibia: Anura: Discoglossidae) viviente en Mallorca. *Doñana Acta Vertebrata* 7:266–269.

ALCOVER J.A., AND J. MAYOL. 1981. Espécies reliquies d'amfibis i de rèptils a les Balears i Pitiüses. *Bolletí de la Societat d'Historia Natural de les Balears* 25:151–167.

ALCOVER J.A., AND J. MAYOL. 1982. Espèces relictuelles d'amphibiens et de reptiles des îles Baléares et Pityuses: un extension des résultats. *Bulletin de la Société Hérpétologique de France* 22:69–74.

ALCOVER J.A., S. MOYÁ-SOLÁ, AND J. PONS-MOYÁ. 1981. *Les Quimeres del Passat. Els vertebrats fossils del Plio-Quaternari de les Balears i Pitiüses*. Monografies Cientifiques, 1. Editorial Moll. Ciutat de Mallorca, Spain. 260 pp.

ALONSO-ZARAZAGA, M.A. 1998. Apéndice 1. Nomenclatura: Lista de sinónimos y combinaciones. Pages 645–685 *in* A. Salvador, ed., *Reptiles, Fauna Ibérica 10*, Museo Nacional de Ciencias Naturales. CSIC. Madrid, Spain.

ARCHIDUQUE LUIS SALVADOR. 2000. *Menorca. Las Baleares. Descritas por la palabra y el dibujo* (*Die Balearen II*). La Foradada (*Serie Mayor*), José J. de Olañeta, Editor. Palma de Mallorca, Spain. 212 pp.

ARMSTRONG, J. 1781. *Historia civil, y natural de la isla de Menorca: descripción topográfica de la cuidad de Mahon, y demás poblaciones de ella: número de sus habitantes, y ganados de todas especies: estado de su comercio activo y pasivo, y cantidad de los frutos que produce.* Imprenta de Pedro Marín. Madrid, Spain. 283 pp.

ARNOLD, E.N. 1973. Relationships of the Palearctic lizards assigned to the genera *Lacerta*, *Algyroides* and *Psammodromus* (Reptilia: Lacertidae). *Bulletin of the British Museum* (*Natural History*) 25(8):289–366.

BALCELLS, E. 1955. Datos para el estudio del ciclo biológico de los gecos del N.E. de España e Islas Baleares. *Publicaciones del Instituto de Biología Aplicada* 20:33–45.

BARCELÓ, F., AND F. COMBIS. 1876. *Catálogo de los reptiles y los moluscos terrestres y de agua dulce observados en las Islas Baleares*. Imprenta P.J. Gelabert, Palma de Mallorca, Spain.

BEDRIAGA, J.V. 1879. Mémoire sur les varietés européennes du Lézard des Murailles. *Bullétin de la Société Zoologique de France* 4:194–228.

BEDRIAGA, J.V. 1886. Beiträge zur Kenntniss der Lacertiden-Familie (*Lacerta, Algyroides, Tropidosauria, Zerzoumia* und *Bettaia*). *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft* 14:17–444.

BOETTGER, O. 1880. Neue Kroenvarietat von den Balearen. *Zoologische Anzeiger* 72:642–643.

BOETTGER, O. 1881. Beitrag zur Kenntnis der Amphibien und Reptilien Spaniens und der Balearen. *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft* 12:371–392.

BÖHME, W. 1996. Biographische Notizien zur Doktorarbeit von Jacques von Bedriaga (1854–1906). *Salamandra* 32(3):193–198.

BÖHME, W. 2004. The German contributions to Mediterranean Herpetology with special reference to the

Balearic Islands and their lacertid lizards. Pages 63–82 *in* V. Pérez-Mellado, N. Riera, and A. Perera, eds., *The Biology of Lacertid lizards. Evolutionary and Ecological* Perspectives. Institut Menorquí d'Estudis, Maó, Menorca, Spain.

BÖHME, W. 2005. Commemorating Martin Eisentraut (1902–1994) — important explorer of tropical African vertebrates. Pages 85–98 *in* B.A. Huber, B.J. Sinclair, and K.H. Lampe, eds., *African Biodiversity: Molecules, Organisms, Ecosystems. Proceedingsoof the 5th International Symposium of Tropical Biology, Museum Koenig*. Springer Verlag, Bonn, Germany.

BÖHME, W., AND R. HUTTERER. 1999. Leben und Werk von Martin Eisentraut (1902–1994). *Bonner zoologische Beiträge* 48 (3–4):367–382.

BOSCÁ, E. 1877. Catálogo de los Reptiles y Anfibios observados en España, Portugal e Islas Baleares. *Anales de la Sociedad Española de Historia Natural* 6:39–69.

BOSCÁ, E. 1880. Catalogue des reptiles et amphibiens de la Peninsule Ibérique et des îles Baléares. *Bulletin de la Société Zoologique de France* 5:240–287.

BOSCÁ, E. 1881. Correcciones y adiciones al catálogo de los reptiles y anfibios de España, Portugal y las islas Baleares, seguido de un resumen general sobre su distribución en la Península. *Anales de la Sociedad Española de Historia Natural* 10:89–112.

BOSCÁ, E. 1883. Exploración herpetológica de la Isla de Ibiza. *Anales de la Sociedad Española de Historia Natural* 12:241–250.

BOULENGER, G.A. 1885–1887. *Catalogue of the Lizards in the British Museum* (*Natural History*). The Trustees of the British Museum, London, England, UK. 3 vols. (Lacertidae in vols. 1 and 2 [1885])

BOULENGER, G.A. 1920. *Monograph of the Lacertidae*. Trustees of the British Museum (Natural History). London, England, UK. 2 vols., 803 pp.

BOUR, R. 1987. L'identité des tortues terrestres européennes – spécimens-types et localités-types. *Revue Française d'Aquariologie* 13(4):111–122.

BRAITMAYER N., U. FRITZ, J. MAYOL, AND A. PIEH. 1998. Die Europäische Sumpfschildkröte (*Emys orbicularis*) Menorcas. *Elaphe* 6(4):57–60.

BRAUN, M. 1877. *Lacerta lilfordi* und *Lacerta muralis*. Zugleich ein Beitrag zur Reptilienfauna der Kleinen Inseln des Mittelmeeres. *Arbeiten aus den zoologischen-zootomischen Institut in Wurzburg* 4:1–64.

BUCHHOLZ, K.F. 1954. Ein neuer *Hemidactylus* von der Balearen (Rept. Gekkonidae). *Bonner Zoologische Beitrage* 5:68.

BULEY, K.R., AND G. GARCÍA. 1997. The recovery programme for the Mallorcan midwife toad *Alytes muletensis*: an update. *Dodo, Journal of the Wildlife Preservation Trusts* 33:80–90.

CASTAÑOS, E. 1930. Las lagartijas negras de Menorca. *Revista de Menorca* 25:53–55.

CASTAÑOS, E. 1943. Catálogo de la historia natural de Menorca en el siglo XVIII. *Revista de Menorca*, año XXXVIII, 6ª época, primer trimestre: 276–281.

CASTAÑOS, E. 1944. Catálogo de la historia natural de Menorca en el siglo XVIII (Continuación). *Revista de Menorca*, año 46, 6ª época, primer trimestre: 49–54.

CIRER, A.M. 1981. *La lagartija ibicenca y su círculo de razas*. Consell d'Ecologi i Medi Ambient d'Eivissa, Ibiza, Spain. 106 pp.

CIRER, A.M. 1982. Estudio de las poblaciones de lacértidos de los islotes en torno a la isla de Ibiza. *Publicaciones del Centro Pirenaico de Biología Experimental* 13:83–88.

CIRER, A.M. 1987a. *Revisión taxonómica de las subespecies del lacértido Podarcis pityusensis, BOSCÁ, 1883.* Ph.D. dissertation. University of Barcelona, Spain. 445 pp.

CIRER, A.M. 1987b. Aplicación de técnicas estadísticas multivariantes a las poblaciones del lacértido *Podarcis pityusensis* (Boscá, 1883). *Revista Española de Herpetología* 2:145–164.

Cirer, A.M. 1987c. New taxonomy proposition for *Podarcis pityusensis* Boscá, 1883. Pages 95–101 *in* J.J. van Gelder and H. Strijbosch, eds., *Proceedings of the 4th Ordinary General Meeting of the Societas Europaea Herpetologica*. Faculty of Sciences Nijmegen. Nijmegen, Netherlands.

CIRER, A.M. 1988. Algunos datos colorimétricos de *Podarcis pityusensis*. *Revista Española de Herpetología* 3(2):197–208.

CIRER, A. M., AND GUILLAUME, C.P. 1986. Electrophoretic analysis of the Pityusic Islands Lizard. Pages 201–206 *in* Z. Roček, ed., *Studies in Herpetology* (*Proceedings of the Third Ordinary General Meeting of*

the Societas Europaea Herpetologica*). Charles University, Prague, Czechoslovakia.

CIRER, A.M., AND J.P. MARTÍNEZ-RICA. 1986. Application of colorimetric techniques to the taxonomy of *Podarcis pityusensis*. Pages 323–326 *in* Z. Roček, ed., *Studies in Herpetology* (*Proceedings of the Third Ordinary General Meeting of the Societas Europaea Herpetologica*). Charles University, Prague, Czechoslovakia.

CIRER, A.M., AND J.P. MARTÍNEZ-RICA. 1990. The polymorphism of *Podarcis pityusensis* and its adaptative evolution in Mediterranean isles. *Herpetological Journal* 1:465–473.

CLEGHORN, G. 1751. *Observations on the Epidemical Diseases in Minorca. From the year 1744 to 1749. To wich is Prefixed, a Short Account of the Climate, Productions, Inhabitants, and Endemical Distempers of that Island.* T. Cadell, D. Wilson and G. Nicol, London, England, UK. xix + 288 pp.

COLOM, G. 1951. Extraña distribución del "*Bufo viridis* Laur." *Iberica* 206:261–264, 277.

COLOM, G. 1952. Notas de biogeografía baleárica. Los Saurios, *Iberica* 15(234):426–429, 434, fig. [p. 434].

COLOM, G. 1953. Biogeografía balear. Los Saurios: su origen y su actual distribución. *Boletín de la Sociedad de Historia Natural de las Baleares* 2:5–20.

COLOM, G. 1957. *Biogeografía de las Baleares*. Diputación provincial de Baleares. Palma de Mallorca, Spain. 568 pp.

COLOM, G. 1978. *Biogeografia de las Baleares. La formación de las islas y el origen de su Flora y de su Fauna*. Diputación Provincial de Baleares, Instituto de Estudios Baleáricos C.S.I.C., Palma de Mallorca, Spain. 515pp.

COLOM, G. 1988. *El medio y la vida en las Baleares*. Direcció General de Cultura. Govern Balear. Palma de Mallorca, Spain. 292 pp.

COMPTE, A. 1966. Resultados de una expedición zoológica a las islas Pitiusas. I. Vertebrados. *Boletín de la Real Sociedad española de Historia Natural* 64:5–46.

COMPTE, A. 1968. La fauna de Menorca y su origen. *Revista de Menorca, Número extra.* 330 pp.

COMPTE, A. 1977. Los ofidios de las islas Baleares. *Boletín de la Real Sociedad Española de Historia Natural* (*Sección Biológica*) 73:263.

CORTI, C., P. LO CASCIO, S. VANNI, G.F. TURRISI, AND A. VACCARO. 1997. Amphibians and reptiles of the circumsicilian islands: new data and some considerations. *Bollettino del Museo regionale di Scienze naturali di Torino* 15(1):179–211.

CORTI, C., M. MASSETI, M. DELFINO, AND V. PÉREZ-MELLADO. (2000). Man and herpetofauna of the Mediterranean islands. *Revista Española de Herpetología* 13:83–100.

DENNETT, D.C. 1999. *La peligrosa idea de Darwin. Evolución y significados de la vida.* Galaxia Gutenberg, Barcelona, Spain. 926 pp.

EISENTRAUT, M. 1928a. Vorlaüfige Diagnosen einiger neuer Rassen der Balearischen Inseleidechse *Lacerta lilfordi* Gthr. *Das Aquarium* 1928:121–124.

EISENTRAUT, M. 1928b. Weitere neue Rassen der Balearischen Inseleidechse *Lacerta lilfordi. Mittelungen Zoologische Museum Berlin* 14:465–468.

EISENTRAUT, M. 1929. Die Variation der balearischen Inseleidechse *Lacerta lilfordi* Gthr. *Sitzungsberiche der Gesellschaft naturforschender Freunde* 1929:24–36.

EISENTRAUT, M. 1930. Beitrag zur Eidechsenfauna der Pityusen und Columbreten. *Mitteilungen aus dem Zoologische Museum Berlin* 16:397–410.

EISENTRAUT, M. 1949. Das Fehlen endemischer und das Auftreten landfremder Eidechsen auf den ebiden Hauptinseln der Balearen, Mallorca und Menorca. *Zoologische Beitrage* 1:3–11.

EISENTRAUT, M. 1950. Eidechsen der Spanischen Mittelmeerinseln und ihre Rassennaufspaltung im Lichte der Evolution. *Mittelungen Zoologische Museum Berlin* 26:1–228.

EISENTRAUT, M. 1954. Der inselmelanismus der Eidechsen und seine Entstechung im Streit der Meinungen. *Zoologischer Anzeiger* 152:317–321.

FRAGA, X.A. 1989. A modernizacion da taxonomia herpetoloxica a fins do XIX no Estado Español: as aportacions de Boscá e Lópz Seoane. *Treballs Societat Catalana d'Ictiologia i Herpetologia* 2:26–33.

FRITZ, U., A. PIEH, P. LENK, J. MAYOL, B. SÄTTELE, AND M. WINK. 1998. Is *Emys orbicularis* introduced on Majorca? Pages 123–133 *in* U. Fritz, ed., *Proceedings of the EMYS Symposium Dresden 96 – Mertensiella*, 10.

GLICK, T.F. 1982. *Darwin en España*. Ediciones Península, Barcelona, Spain. 122 pp.

GÓMEZ, R.M., AND B. SANCHÍZ. 1987. Notes on the Spanish XIX century herpetology, Pages 151–154 *in* J.J. van Gelder and H. Strijbosch, eds., *Proceedings of the 4th Ordinary General Meeting of the Societas Europaea Herpetologica*. Faculty of Sciences Nijmegen. Nijmegen, Netherlands.

HARTMANN, M. 1953. Die Rassenaufspaltung der balearischen Inseleidechsen. *Zoologische Jahrbuch Physiologie* 64:88–96.

HEMMER, H., AND J.A. ALCOVER, EDS. 1984. *Història Biològica del ferreret*. Editorial Moll, Ciutat de Mallorca, Spain. 252 pp.

JURADO, J.R. 2006. Lluís Pou i Francesc Barceló, dues FIGURES senyeres. *El Busqueret* 12:1–19.

HEMMER, H., AND B. KADEL. 1980. Studien am Wasserfrosch – *Rana perezi* (Seoane, 1885) – der Balaearen (Amphibia, Anura, Ranidae). *Bulletí de la Societat d'Historia Natural de les Balears* 24:55–70.

HUXLEY, J.S., ED. 1940. *The New Systematics*. Clarendon Press, Oxford, England. 583 pp.

KRAAIJEVELD-SMIT, F.J.L., G. ROWE, T.J.C. BEEBEE, AND R.A. GRIFFITHS. 2003. Microsatellite markers for the Mallorcan midwife toad *Alytes muletensis*. *Molecular Ecology Notes* 3:152–154.

KRAAIJEVELD-SMIT, F.J.L., T.J.C. BEEBEE, R.A. GRIFFITHS, R.D. MOORE, AND L. SCHLEY. 2005. Low gene flow but high genetic diversity in the threatened Mallorcan midwife toad *Alytes muletensis*. *Molecular Ecology* 14:3307–3315.

LILGE, D. 1975. Systematisch-biometrische Untersuchungen an *Lacerta pityusensis* (Sauria, Lacertidae). *Salamandra* 11(3/4):145–178.

MALUQUER, J. 1917. Noves herpetològiques. *Institució Catalana d'Historia Natural* 17:108–111.

MALUQUER, J. 1918. I. Sobre el *Coluber longissimus* Laurenti. –II. Presencia de la *Lacerta viridis* Daudin, en Cataluña. – III. ¿La *Testudo graeca* Linné, en Formentera? *Boletín de la Real Sociedad Española de Historia Natural* 18 402–406.

MALUQUER, J. 1919. Presencia de la *Testudo ibera* Pallas, en Formentera. *Boletín de la Real Sociedad Española de Historia Natural* 19:384–385.

MARTÍNEZ Y SÁEZ, F. 1875. Nota sobre algunos reptiles de Menorca. *Anales de la Sociedad Española de Historia Natural Actas* 4:93–94.

MARTÍNEZ-RICA, J.P. 1965a. La distribution des geckos dans les Pithyuses. *Rapports et Procès-verbaux des réunions de la C.I.E.S.M.M.* 18(2):42–43.

MARTÍNEZ-RICA, J.P. 1965b. Exploración de las Islas Pitiusas: Gecónidos. *Miscelánea Zoológica* 2(1): 133–137.

MARTÍNEZ-RICA, J.P. 1967a. Reptiles hallados o citados en Menorca. *Revista de Menorca* 1967(3):211–216.

MARTÍNEZ-RICA, J.P. 1967b. Las comunidades naturales del sur de Menorca. *Revista de Menorca* 1967(4): 233–311.

MARTÍNEZ-RICA, J.P. 1974. Contribución al estudio de la Biología de los gecónidos ibéricos (Rept., Sauria). *Publicaciones del Centro Pirenaico de Biología Experimental* 5:1–291.

MAYOL, J. 1981. Presencia de gecònids (Rept., Sauria) als illots Balears. *Mayurqa* 17:167–173.

MAYOL, J. 1985. *Rèptils i amfibis de les Balears*. Editorial Moll. Palma de Mallorca, Spain. 234 pp.

MAYOL, J. 1992. Mortalidad de *Tarentola mauritanica* en caminos rurales de Menorca. Nota preliminar. *Boletín de la Asociación Herpetológica Española* 3:25–26.

MAYOL, J. 2003. *Rèptils i amfibis de les Balears*. Editorial Moll. 2nd edition. Palma de Mallorca, Spain. 249 pp.

MAYOL, J., AND J.A. ALCOVER. 1981. Survival of *Baleaphryne* Sanchiz and Adrover, 1977 (Amphibia: Anura: Discoglossidae) on Mallorca (Short Note). *Amphibia-Reptilia* 1(3/4):343–346.

MAYOL, J., J. MUNTANER, AND R. AGUILAR. 1988. Incidencia de la pesca accidental sobre las tortugas marinas en el Mediterráneo español. *Bolletí de la Societat d'Historia Natural de les Balears* 32:19–31.

MAYR, E. 1963. *Animal Species and Evolution*. The Belknap Press, Harvard University Press, Cambridge, Massachusetts, USA. 797 pp.

MAYR, E. 1969. *Principles of Systematic Zoology*. Tata McGraw-Hill Publising Company Ltd., New Delhi, India. 428 pp.

MAYR, E., AND P.D. ASHLOCK. 1991. *Principles of Systematic Zoology*. McGraw-Hill, New York, New York, USA. 475 pp.

MERTENS, R. 1921. Eine neue Eidechse von den Pityusen. *Senckenbergiana* 3:142–146.

MERTENS, R. 1924. Herpetologische Mitteilungen II. Bemerkungen über einige Eidechsen Süditaliens, Siziliens und Menorcas. *Senckenbergiana* 6:178–180.

MERTENS, R. 1927. Über die rassen der Pityuseneidechse (*Lacerta pityusensis*). *Zoologische Anzeiger* 69:299–304.

MERTENS, R. 1929. *Lacerta (Scelaris) perspicillata* Dumeril et Bibron-eine für Europa neue Eidechse. *Zoologische Anzeiger* 85:1–2.

MERTENS, R. 1934. Die Insel-Reptilien, ihre Ausbreitung, Variation und Artbildung. *Zoologica* 84:1–108.

MERTENS R. 1957. Mallorca: ein herpetogeographisches Problem. *Zoologische Beiträge Berlin* 3:1–16.

MERTENS, R. 1958. Über die balearische Toro-Eidechse, *Lacerta lilfordi toronis*. *Senckenbergiana biologie* 39 (1/2):47–50.

MERTENS, R., AND L. MÜLLER. 1928. Die Amphibien und Reptilien Europas. *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft* 41:1–62.

MERTENS, R., AND L. MÜLLER. 1940. Die Amphibien und Reptilien Europas (Zweite Listen ach dem Stande von Januar 1940). *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft* 451:1–56.

MERTENS, R., AND H. WERMUTH. 1960. *Die Amphibien und Reptilien Europas* (*Dritte Liste nach dem Stand vom 1.Januar 1960*). G. Kramer, Frankfurt am Main, Germany. 264 pp.

METHNER, K. 1980. Zur Vorkommen der Europäischen Sumpfschildkröte (*Emys orbicularis*) auf Menorca/Balearen (Spanien). *Salamandra* 16:132–134.

METHNER, K. 1988. Zum Vorkommen von *Emys orbicularis* (Linnaeus, 1758) auf Menorca (Balearen) II (Testudines: Emydidae). *Salamandra* 24(4):302–305.

MONTORI, A., J. MALUQUER MARGALEF, AND X. PASCUAL. 1985. Síntesi històrica dels estudis herpetològics als Països Catalans. *Butlletí de la Institució Catalana d'Història Natural* 50:173–185.

MÜLLER, L. 1927a. Beitrag zur Kenntnis der Rassen von *Lacerta lilfordi. Zoologische Anzeiger* 73:257–269.

MÜLLER, L. 1927b. Zwei weitere Rassen der *Lacerta lilfordi. Zoologische Anzeiger* 74:185–194.

MÜLLER, L. 1928a. Zweiter Beitrag zur Kenntnis der Rassen von *Lacerta lilfordi* von del Pityusen. *Zoologische Anzeiger* 78:261–273.

MÜLLER, L. 1928b. Vorläufige Mitteilung über eine weitere Rasse der *Lacerta lilfordi* von den Pityusen. *Blätter für Aquarien- und Terrarienkunde* 39:386–388.

MÜLLER, L.1928c. Die Inselrassen der *Lacerta lilfordi. Verhandlungen der Deutschen Zoologischen Gesellschaft* 1928:333–337.

MÜLLER, L. 1928d. Vorläufige Mitteilung über eine weitere Rasse der *Lacerta lilfordi. Blätter für Aguarien- und Terrarien-kunde* 39:471–473.

OLÉO Y QUADRADO, R. 1876. *Historia de la isla de Menorca*. (Edición Facsímil). Tomo I. Ediciones Nura. Menorca, 2000.

OTERO CARVAJAL, L.E. 2001. La destrucción de la ciencia en España: Las consecuencias del triunfo militar de la España franquista. *Historia y Comunicación Social* 6:149–186.

PALMER, M., PONS, G.X., J. CAMBEFORT, AND J.A. ALCOVER. 1999. Historical processes and environmental factors as determinants of inter-island differences in endemic faunas: the case of the Balearic Islands. *Journal of Biogeography* 26:813–823.

PÉREZ-MELLADO, V. 2005. Amfibis i Rèptils, Pages 117–295, *in* J.M. Vidal Hernández, ed., *Enciclopèdia de Menorca. V: Vertebrats (volum 2). Peixos, Amfibis i Rèptils*, Obra cultural de Menorca. Maó, Menorca, Spain.

PÉREZ-MELLADO V., AND A. SALVADOR. 1981. Actividad y termorregulación estival de *Podarcis pityusensis* Bosca, 1883 (Sauria, Lacertidae) en Ibiza y Formentera. *Amphibia-Reptilia* 2:181–186.

PÉREZ-MELLADO, V., AND A. SALVADOR. 1988. The Balearic lizard: *Podarcis lilfordi* (Günther, 1874) (Sauria, Lacertidae) of Menorca. *Arquivos do Museu Bocage* 1(10):127–195.

PONS, G., AND M. PALMER. 1996. *Fauna endémica de les Illes Balears*. IDER. Govern Balear y Societat d'Història Natural de les Balears, Palma de Mallorca, Spain. 307 pp.

RAMIS I RAMIS, J. 1814. *Specimen animalium, Vegetabilium et mineralium in insula Minorica frecuentiorum ad norman Linneani sistematis. Exaratum. Accedunt nomina Vernacula in quantum fieri potuit.* Excudebat Petrus Antonius Serra, Maó, Menorca, Spain. 60 pp.

RAXWORTHY, C.J. 1984. Hermann's tortoise (*Testudo hermanni robertmertensi* Wermuth) on Minorca, Balearic Islands (Short note). *British Journal of Herpetology* 6:385–386.

RODRÍGUEZ FEMENIAS, J.J. 1887. *Historia Natural de las Baleares. Zoolojía. Adiciones á la fauna balear.* Imprenta Fábregas, Mahón, Spain. 6 pp.

SALVADOR, A. 1974. *Guía de los anfibios y reptiles españoles.* Instituto Nacional para la Conservación de la Naturaleza, Madrid, Spain. 282 pp.

SALVADOR, A. 1976a. *La Alimentación de los reptiles de Cabrera.* M.D. dissertation. Universidad Complutense de Madrid. 20 pp.

SALVADOR, A. 1976b. Materiales para una "Herpetofauna balearica". 1. Las lagartijas baleares de la isla Malgrats. *Boletín de la Estación Central de Ecología* 5:73–79.

SALVADOR, A. 1978. Materiales para una "Herpetofauna balearica". 5. Las salamanquesas y tortugas del archipiélago de Cabrera. *Doñana Acta Vertebrata* 5:5–17.

SALVADOR, A. 1979a. Materiales para una "Herpetofauna balearica". 2. Taxonomía de las lagartijas baleares del archipiélago de Cabrera. *Bonner Zoologische Beitrage* 30(1/2):176–191.

SALVADOR, A. 1979b. Una nueva subespecie melánica de lagartija balear (*Lacerta lilfordi*). *Boletín de la Real Sociedad Española de Historia Natural* (*Biología*) 77:491–492.

SALVADOR, A. 1980a. Interaction between the balearic lizard (*Podarcis lilfordi*) and Eleonora's falcon (*Falco eleonorae*). *Journal of Herpetology* 14:101.

SALVADOR, A. 1980b. Materiales para una "Herpetofauna balearica". 4. Las poblaciones de lagartija balear (*Lacerta lilfordi*) del archipiélago de Cabrera. Pages 401–454 in *Actas de la I Reunión Iberoamericana de Zoología de Vertebrados*. Mérida, Spain.

SALVADOR, A. 1984. A taxonomic study of the Eivissa wall lizard. Pages 393–427 *in* H. Kuhbier, J.A. Alcover, and T. Guerau d'Arellano, eds., *Biogeography and Ecology of the Pityusic Islands.* Dr W.Junk Publishers, The Hague, Netherlands.

SALVADOR, A. 1986a. *Podarcis lilfordi* (Günther, 1874) — Balearen Eidechse. Pages 83–110 *in* W. Böhme, ed., *Handbuch der Amphibien und Reptilien Europas*, *Echsen III* (*Podarcis*). Aula-Verlag, Wiesbaden, Germany.

SALVADOR, A. 1986b. *Podarcis pityusensis* (Boscá, 1883) — Pityusen Eidechse. Pages 231–253 *in* W. Böhme ed., *Handbuch der Amphibien und Reptilien Europas*, *Echsen III* (*Podarcis*). Aula-Verlag, Wiesbaden, Germany.

SALVADOR, A., AND V. PÉREZ-MELLADO. 1984. The Amphibians and Reptiles of the Pytiusic Islands. Pages 429–439 *in* H. Kuhbier, J.A. Alcover, and T. Guerau d'Arellano, eds., *Biogeography and Ecology of the Pityusic Islands*. Dr W.Junk Publishers, The Hague, Netherlands.

SÁNCHEZ ARTEAGA, J.M. 2005. Eduardo Boscá Casanoves y la renovación taxonómica de los catálogos faunísticos en España durante el último tercio del siglo XIX. *Asclepio* 57(2):81–108.

SANCHÍZ, F.B., AND R. ADROVER. 1977. Anfibios fósiles del Pleistoceno de Mallorca. *Doñana Acta Vertebrata* 4:5–25.

SANDERS, E.D. 1984. Evidence concerning late survival and extinction of endemic Amphibia and Reptilia from the Bronze and Iron Age settlement of Torralba d'en Salort (Alayor, Menorca). Pages 123–127 *in* H. Hemmer, and J.A. Alcover, eds., *Historia Biologica del Ferreret* (*Life History of the Majorcan Midwife Toad*). Monografies Cientifiques 3, Editorial Moll, Palma de Mallorca, Spain.

SMITH, C.H. 2005. Günther, Albert Charles [Karl] Lewis [Ludwig] Gotthilf (Germany-England 1830–1914). In Some Biogeographers, Evolutionists and Ecologists, Chrono-Biographical Sketches. <*http://www.wku.edu*> Cited 30 October 2006.

USERA, J., AND C. ALBEROLA. 2005. La obra científica y de divulgación de Guillem Colom Casasnovas (1900–1993). In Galería de Paleontólogos, <*http://www.ugr.es*> Cited 30 October 2006.

VICKERS, B.R. 1983. History of *Emys orbicularis* on Menorca (Short note). *British Journal of Herpetology* 6: 310.

VIDAL, A. 1965. Les Batraciens des îles Pituyuses. *Communications int. Exploration scientifique Mer Méditérranée Rapports* 18(2):561–564.

VIDAL, A. 1966. Estudio biológico de las islas Pitiusas: Anfibios. *Publicaciones del Instituto de Biología Aplicada* 40:81–112.

VIDAL HERNÁNDEZ, J.M. 1995. La historia natural menorquina de la segona mitat del segle XIX i el naixement de l'algologia de la Mediterrània Occidental. Pages 427–455 *in* J.M. Camarasa and A. Roca, eds., *Ciència y tècnica als Països Catalans: una aproximació biogràfica.* Fundació Catalana per a la Recerca, Barcelona, Spain.

VIDAL HERNÁNDEZ, J.M. 1997. Las ciencias naturales en Menorca a lo largo del siglo XIX. *Zubía Monográfico* 9:53–70.

VIDAL HERNÁNDEZ, J.M. 1999. Joan Ramis, naturalista de camp o naturalista de cap. Pages 219–256 *in* M. Paredes, M., and J. Salord, eds., *Joan Ramis i Josep M. Quadrado: de la Il-lustració al romanticisme.* Publicacions de l'Abadia de Montserrat, Barcelona; Palma de Mallorca: Universitat de les Illes Balears and Institut Menorquí d'Estudis (Biblioteca Miquel dels Sants Oliver, 9), Maó, Menorca, Spain.

VIDAL HERNÁNDEZ, J.M. 2002. Les dècades prodigioses de la ciència a la Menorca del XIX. *Randa* 47:5–34.

VIDAL HERNÁNDEZ, J.M. 2003. Naturalistes menorquins i estrangers a Menorca en el darrer terç del segle XIX. Un model de xarxa científica. Pages 135–143 in *Actes de la VII Trobada d'Historia de la Ciència i de la Técnica.* Societat Catalana d'Historia de la Ciència i de la Tècnica, Barcelona, Spain.

VIDAL HERNÁNDEZ, J.M. 2005. Addenda II. Biografies d'alguns ictiòlegs que van escriure sobre els peixos de Menorca. Pages 101–107 *in* J.M. Vidal Hernández, ed., *Enciclopèdia de Menorca. V: Vertebrats (volum 2). Peixos, Amfibis i Rèptils.* Obra cultural de Menorca, Maó, Menorca, Spain.

VIVES-BALMAÑA, M.V. 1987. 1. Generalitats. 2. Aspectes històrics de l'estudi dels rèptils als Països Catalans. Pages 121–122 in *Història Natural dels Països Catalans. 13. Amfibis, Rèptils i Mamífers.* Enciclopèdia Catalana S.A., Barcelona, Spain.

WERMUTH, H. 1952. *Testudo hermanni robertmertensi* n. subsp. und ihr Vorkommen in Spanien. *Senckenbergiana* 33(1/3):157–164.

WETTSTEIN, O. 1937. Über Balearen-Eidechsen. *Zoologischer Anzeiger* 117:293–297.

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Local Ornithologists and the Early Study of Central Mediterranean Avifauna: the Role of Schembri and Damiani in the Maltese and Tuscan Islands

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The development of Ornithology in the Mediterranean basin largely took place in the course of the 19th century, when many field studies — mainly inspired by the fashion of scientific collections — led to the exploration of the bird fauna of its coasts and islands. Museum researchers based in some of the countries edging the Mediterranean had of course an important role (and an easier one). As a rule, however, their activity did not reach the very remote islands or the less accessible coasts. Ornithologists from England and Germany (i.e. from the two major schools existing at that time: Stresemann 1975), instead, pioneered the marine and insular approach, prevailing on the western and eastern sectors of the Mediterranean, respectively. There are, of course, many exceptions to this rather simplified view, such as the British activity in Egypt or that of the naturalists from the Piedmont Kingdom in Sardinia. The latter led to the description of important Mediterranean endemic species (such as *Falco eleonorae*, and *Sylvia sarda*). Nevertheless, this sort of dichotomic tradition went on well into the next century and well outside the museum approaches (*cf.* Mountfort 1958 on exploration of the Andalusian wetlands, Ristow et al. 1991 on long-term studies of seabirds and falcons on Crete and many other examples).

Only on a few of the very large islands were some local naturalists active in the study of birds: Luigi Benoit and several others in Sicily, Gaetano Cara and Pietro Bonomi (and, already in the 18th century, Francesco Cetti) in Sardinia. The lack of local expertise on all of the smaller islands, characterized not only the study of birds but probably many other aspects of culture and was no doubt due to local economy, living conditions, and even to small human population sizes, not to mention the difficulties of transportation. Although motorized navigation originated in the Mediterranean (Naples, 1818), for many years most connections depended on sail.

Two different islands of a similar, medium size, both located in central Mediterranean but very different from each other in nature and history, gave birth to two most notable personalities whose ornithological contributions went far beyond the publication of a travelogue or that of an occasional list of birds. These personalities are Antonio Schembri and Giacomo Damiani who lived at different times; Schembri in fact died about the time Damiani was born.

Antonio Schembri

Antonio Schembri (Fig. 1) was born in Valletta, Malta, in April 1813 of a relatively rich and educated family. He died at the age of 59, in December 1872. Valletta was in the early 1800s a relatively large town, a strategic harbour, as well as an important trading center. Schembri himself was at the age of 25 director of his father's business that handled the maritime transport of merchan-

dise. During his relatively short life he published several books and papers on a variety of subjects dealing with ornithology, economics, agriculture, emigration, and biographies amongst others. He is also remembered for collecting a fly which was named after him by Camillo Rondani (*Ochthera schembrii*).

Besides his numerous publications, and his active involvement in various Maltese societies and government commissions, Antonio Schembri is mostly referred to as the father of Maltese ornithology (Attard 1972). He identified a niche in the natural history of Malta that had not been exploited. In fact, only general references and travelogues were available at that time on the Maltese birds. In spite of his various commitments, not least of which was his family's business, he made an excellent contribution to ornithology by producing within a short period of three years, from 1843 to 1846, three large scientific publications. His first publication laid down the foundations of Maltese Ornithology.

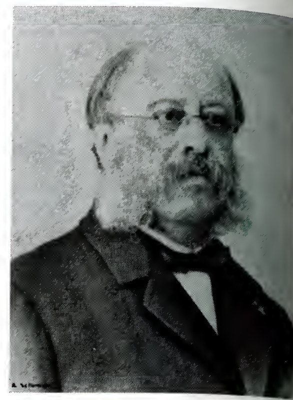

FIGURE 1. Antonio Schembri. Photo courtesy of J.M. Attard Tabone.

In 1843 he published, in Italian, the first scientific annotated checklist of the birds of the Maltese Islands *Catalogo Ornitologico del Gruppo di Malta*, treating 299 wild species and 4 domestic ones. In most cases he avoided describing the birds so as, in his own words, not to repeat what had appeared previously in works by Coenraad Jacob Temminck, Paolo Savi and John Gould. However, he gave a plumage description of those birds that were not included in Savi's work, such as the houbara bustard, *Chlamidotis undulata*, for instance. He followed the classification order used by Savi and in many ways the style of the *Ornitologia Siciliana* by Luigi Benoit (1840), published only three years earlier. He frequently corresponded with Benoit. He described the status of all the birds known to occur in the islands and added the Maltese, English, and French names for most of the species. He also described in detail and illustrated the storm-petrel breeding on the islet of Filfla, claiming that it was a new species for science, and naming it *Thalassidroma melitensis*. It was not a new species, but no one could really blame him for having believed so, because earlier descriptions of *Thalassidroma pelagica* (= *Hydrobates pelagicus*) had left out some characteristics, which he had noted in the birds breeding on the islet. He has been, since then, somewhat vindicated as the population of the storm-petrel in the Mediterranean is now regarded as a different subspecies from the Atlantic form (Cagnon et al. 2004), and of course his denomination could not be disregarded, our birds being now *Hydrobates pelagicus melitensis* Schembri.

Besides commenting on the status of many common species, he was able to document the occurrence of many rarities, which is perhaps not surprising in view of the collection-inspired habits of his time. And he did this with extreme precision. He reported, for instance, the case of great bustards crashing into the Ta Cenc' cliffs on Gozo Island while migrating in stormy weather, and many similar details.

In the same year of his *Catalogo* (1843), he published also the *Quadro Geografico Ornitologico Ossia Quadro Comparativo dell'Ornitologia di Malta, Sicilia, Roma, Toscana, Liguria, Nizza e la Provincia di Gard*. This was a comparative ornithological study. He compared the ornithology of Malta, Sicily, Rome, Tuscany, etc., and listed the species in their respective columns for each place, giving brief general information on them (mostly range and breeding habitat). This was, perhaps, the earliest publication to cover at one time the ornithology of several different places in central southern Europe. No doubt he was inspired by Charles L. Bonaparte, whose two publications (*Specchio Comparativo delle Ornitologie di Roma e Filadelfia* in 1827 and *Geographical and Comparative List of the Birds of Europe & North America* in 1838) advocated the views of

Georges-Louis Leclerc, Comte de Buffon, of how beneficial the comparison of birds of various regions was to ornithology. Schembri corresponded regularly with Bonaparte, who helped him when he was compiling his *Catalogo*. On the other hand, Schembri helped Bonaparte when the latter was working on his monumental *Iconografia della Fauna Italica*, wherein Bonaparte described for the first time the trumpeter finch *Bucanetes githagineus*, from a live specimen sent to him by Schembri. Also in the entry for the pin-tailed sandgrouse, *Pterocles alchata*, Bonaparte wrote "*Vivo noi lo avemmo da Malta: e ciò fu dono del valente giovane signor Antonio Schembri nativo di quell'isola, dal quale ricevemmo insieme cento altri oggetti graditi*".

After the publication of the the *Catalogo* and the *Quadro Geografico*, H.E. Strickland in his *Recent Progress and Present State of Ornithology*, published in 1845, stated that "The Island of Malta possesses an able ornithologist in Sig^{r} Schembri" and his two publications "form almost the first works on zoology ever printed in the island of Malta, and they show that, even in the most insulated localities, an active naturalist will always find abundant occupation".

Apart from the two publications mentioned above, Schembri's highly-esteemed contribution to European ornithology is found in his third book "*Vocabolario dei Sinonimi Classici dell' Ornitologia Europea*" that was published in Bologna in 1846 but earlier presented in manuscript form by Schembri himself with a brief introductory oral presentation at the 7th *Congresso degli Scienziati Italiani*, held in Naples in 1845. The *Vocabolario* gained for him a European ornithological reputation.

Schembri was well versed in the ornithological literature and had a vast library, which included all the best-known ornithological publications of his time, and he made good use of these by always referring to them in his works. He had a large personal collection of mounted birds, as well as shells, insects, and fossils. Unfortunately, none of his collections, personal papers or manuscripts have survived and only a few of his books have been traced, such as his copies of Bonaparte's *Iconografia*.

Giacomo Damiani

If Antonio Schembri's name is still well known, at least within the context of the history of Mediterranean ornithology, that of Giacomo Damiani (Fig. 2) — native of Elba Island — has been almost totally forgotten for many decades. After having written several papers on birds, fishes, and cetaceans, and after having participated in all of the early Italian Zoological congresses, and having been the local organizer of one of them (in 1905), he seems to have simply vanished from the scene a couple of decades before he died in 1944. Indeed, an obituary announcing his death was never even published.

FIGURE 2. Giacomo Damiani in 1924, during his Forlì period. Photo courtesy Mr. Dubraver.

Giacomo Damiani was born in August 1871 into a wealthy family at Magazzini, in the countryside facing the Gulf of Portoferraio, on Elba. In this villa (now turned into a psychiatric hospital), he spent almost all his life, at least until 1913, when he left the island, only to return in 1937, when he retired from work and went to live in another house not far off, at Schiopparello. As a profession, he was a teacher of Natural Sciences in the secondary schools, having graduated from the University of Genoa, where he had studied under the supervision of Prof. Corrado Parona. His interest in birds started undoubtedly when he was very young, perhaps simply from bird-catching at his family's *paretaio* (clap-nets) near Magazzini, which is mentioned in a couple of his early writings. But he probably never turned into a fanatical

hunter himself; in fact, in later papers, he often reports on rarities shot by his elder brother, Paolo, or by other people. By the age of 20, he had already been in contact with Enrico Giglioli, the leading Italian ornithologist of the time, who was based at the museum in Florence. Damiani's name actually appeared for the first time — as an author — on the pages of the *Bollettino del Naturalista* in 1891, a brief announcement to the readers that the publication of the results of Giglioli's national ornithological inquiry were going to be postponed. In the same journal, in 1892 and 1893, he published three parts of a long paper titled 'Rondini e Rondoni' (martins and swifts), in which he analysed Giglioli's data about these species on a national basis, adding some personal remarks from his area, such as about 'thousands' of alpine swifts screaming around Palmaiola islet, where they are no longer present. His effort is one of the few real analyses of Giglioli's data, with observations arranged into tables, utilizing a comparative approach, which is virtually absent in Giglioli's books (1886, 1889–1891, 1907). In the same year (1892), two more of his papers appeared: the first dealt with marine fishes ('Prima contribuzione alla ittiofauna del mare dell'Elba'), also perhaps inspired by Giglioli, who was an icthyologist in his spare time, and the second, which was to be the first of his 'Note ornitologiche dall'Elba', a series of papers published during the next 20 years in which he reported with a variable frequency all his ornithological findings. At the end of 1892, Damiani regretted having to decrease his monitoring efficiency in order to attend university courses on the mainland. In this Genoan period, however, he was able to maintain close contacts with his monitoring network on Elba. Specimens were mailed to him in Genoa (even large-sized items such as a black-throated diver, *Gavia arctica*, which had been shot at Portoferraio salt-pans in Dec. 1892), and he regularly returned home for the summer holidays. His periodic reports, both on birds and fishes, did not really decrease. In 1895, he wrote on a broader subject, the irruptive migrations of Pallas's sandgrouse, *Syrrhaptes paradoxus,* and razorbill, *Alca torda*, with original data about the latter species from Elba as well as from the Gulf of Genoa. This was followed in 1896 by a monographic paper on the gobiid fishes of Italy, a couple of papers on the fishes of the Genoan sea and an interesting discussion 'on the correct attributes' to be used for describing the phenology of migratory birds, again, quite a modern effort at standardization, in which he tried to separate the concepts of abundance, regularity and frequency of appearence. His Genoan stay ended in this year (1896).

Once back on Elba, his activity flourished. In a short note on the bluethroat (*Luschinia svecica*), he welcomed the forthcoming birth of a new national journal, the first specifically devoted to birds. To this new journal, *Avicula*, he transferred most of his regular 'note ornitologiche' and he wrote important papers on little known seabirds (*Larus audouinii*, "I *Puffinus* dell'Elba") as well as the catalogue of the Toscanelli local bird collection. However, he did not forget the *Proceedings of the Ligurian Society of Natural History,* which he had exploited during his Genoan years, offering two new papers on *Phalaropus hyperboreus* and on the first Italian record of *Turdus ustulatus*, an American vagrant.

At the turn of the century, good and bad things happened: in 1901 he married Licinia Boni, ten years younger, and at the same time the salt pans of Portoferraio were destroyed to make room for industrial development; these were the last remaining salt pans of Tuscany, those on the mainland having been destroyed long before, and they represented a unique habitat where nearly all Damiani's waterbirds had been recorded. In these years, he not only continued sending lots of specimens to the museum in Florence, but he was also directly involved in assembling a large zoological collection, "la collezione Elbana", which belonged first to Cavalier Tonietti and then to Oreste Del Buono, being hosted at Villa San Martino (until about 15 years ago, more than 900 bird specimens remained in the collection). In 1903, Damiani participated in the Rimini Congress of the Unione Zoologica Italiana with a talk on sharks, and in 1905 he organized a meeting of the same congress

on Elba. 'His' congress was opened with some unusually enthusiastic words of praise by the mayor of Portoferraio, that was not too surprising inasmuch as the mayor was Giacomo's brother, not Paolo, the hunter, whom we have already met, but Leone Damiani, a lawyer.

During his main years of scientific activity, Damiani, writing on Italian dolphins, offered the first evidence for *Stenella coeruleoalba*, a species that is common nowadays but at the time was not (or was not recognized). He then recorded the very rare Minke whale, *Balaenoptera acutorostrata*, and observed other cetacean strandings, such as a fin whale, *Balaenoptera physalus,* a photo of which is still hanging at his home. As for birds, he described the crossbill, *Loxia curvirostra*, invasions in one of the last *Avicula* issues (the journal ceased publishing in 1910) and greeted the newly founded *Rivista Italiana di Ornitologia* with a large, general paper on the birds of the Tuscan Archipelago, hosted in the first volume and coauthored with E. Arrigoni degli Oddi. This is perhaps the best known of his publications. In the same journal, in 1913, he presented an accurate overview about the gannet in Italy (*Sula bassana*). But this, and his note on *Regalecus*, were the last of his scientific papers; both written when he was still quite young, only 42 years old. This sudden silence clearly coincided with his move from Elba to teach in Genoa. It was followed by a second move to Forlì before 1922 and a third to Brescia in 1933. His silence was only interrupted in 1923, during his years at the R. Liceo di Forlì, when his friend Sandro Foresi — an active editor in Portoferraio — persuaded him to write a section for the zoological chapter for the geographic guide 'L'Elba Illustrata'. In this same book, his brother Leone — the former mayor — wrote an historical chapter, together with a few other authors, all of them *'figli diletti dell'isola nostra, che hanno i titoli maggiori per dirne degnamente'* and who were chosen by Foresi as co-workers. Giacomo's pages do not sound at all like the product of a person who is no longer interested in the area; he speaks of sperm whales that he saw in the summer of 1921, well after he had moved, of his dreams for the creation of a marine biology station at the Enfola Peninsula, in place of the ancient tuna fishtrap, and he complains about the rarity in Italy of the 'field ornithologists' (in English in his text), a category that is even rarer than the most vagrant bird species. The reasons for his silence, therefore, are impossible to understand. He died in October 1944 at his Schiopparello home, being survived by his wife, who lived for many years thereafter.

Damiani's role, particularly as an ornithologist, is remarkable. Elba Island was only mentioned in the national bird literature in a 17th century report about canaries said to have escaped from a wrecked vessel (actually Corsican finches *Serinus corsicanus* [*fide* Barbagli and Violani 1997]), then for a couple of species mentioned by Savi (1827–1831), and for a few specimens sent by Toscanelli to Florence museum (Giglioli 1886). In only a few years, Damiani's most accurate 'note ornitologiche dall'Elba' earned this island the nickname of 'the Helgoland of the Mediterranean' by Arrigoni. Helgoland Island, in the North Sea, after the popular studies by Gaetke (1891), had a strong evocative power even in Italy, being synonymous with bird migration, and a migratory bottleneck of utmost importance and of almost mythical proportions. This was perhaps the best acknowledgment of his activity.

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Literature Cited

ATTARD, J.M. 1972. Chevalier Antonio Schembri (1813–1872) Father of Maltese Ornithology. *Il-Merill* 9:5–20.

BARBAGLI, F., AND C. VIOLANI. 1997. Canaries in Tuscany. *Bollettino del Museo Regionale di Scienze Naturali Torino* 15:25–33.

BENOIT, L. 1840. *Ornitologia Siciliana o sia Catalogo Ragionato degli uccelli che si trovano in Sicilia*. Stamperia di Giuseppe Fiumara, Messina, Italia. 231 pp.

RISTOW, D., F. FELDMANN, W. SCHARLAU, C. WINK, AND M. WINK. 1991. Population dynamics of Cory's Shearwater (*Calonectris diomedea*) and Eleonora's Falcon (*Falco eleonorae*) in the Eastern Mediterranean. Pages 199–212 *in* A. Seitz and V. Loeschcke, eds., *Species Conservation: A Population-Biological*. Birkhäuser Verlag, Basel, Switzerland.

CAGNON, C., B. LAUGA, G. HÉMERY, AND C. MOUCHÈS. 2004. Phylogeographic differentiation of storm petrels (*Hydrobates pelagicus*) based on cytochrome *b* mitochondrial DNA variation. *Marine Biology* 145: 1257–1264.

GÄTKE, H. 1891. *Die Vogelwarte Helgoland*. Meyer, Braunschweig, Germany. 609 pp.

GIGLIOLI, E.H. 1886. *Avifauna Italica*. Le Monnier, Firenze, Italia. 623 pp.

GIGLIOLI, E.H. 1889. *Primo resoconto dei risultati dellÍnchiesta Ornithologica in Italia. Parte prima. Avifaune Italica*. Le Monnier, Firenze, Italia. 706 pp.

GIGLIOLI, E.H. 1890. *Primo resoconto dei risultati dellÍnchiesta Ornithologica in Italia. Parte seconda. Avifaune Italica*. Le Monnier, Firenze, Italia. 706 pp.

GIGLIOLI, E.H. 1891. *Primo resoconto dei risultati dellÍnchiesta Ornithologica in Italia. Parte terza. Notizie di Indole generale*. Le Monnier, Firenze, Italia. 518 pp.

GIGLIOLI, E.H. 1907. *Secondo resoconto del risultati dellÍnchiesta Ornithologica in Italia. Avifauna Italica*. San Giuseppe, Firenze, Italia. 784 pp.

MOUNTFORT, G. 1958. *Portrait of a Wilderness*. Hutchinson, London, UK. 240 pp.

SAVI, P. 1827–1831. *Avifauna Toscana*. Nisti, Pisa, Italia. 3 vols. (reprinted 1959; Ferriani, Milano, Italia. 2 vols. 918 pp.)

STRESEMANN, E. 1975. *Ornithology from Aristotle to the Present*. Translated by H.J. Epstein and C. Epstein. Harvard University Press, Cambridge, Massachusetts, USA. 432 pp.

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Scientific Exploration in the Mediterranean Region
Biodiversity of the Mediterranean Opisthobranch Gastropod Fauna: Historical and Phylogenetic Perspectives

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Opisthobranch gastropods are marine animals that differ from most other mollusks in having a reduced shell. The systematics, therefore, is based largely on the study of the soft parts, and this attracts a distinct group of specialists. Explorers of the Mediterranean opisthobranch fauna include a substantial number of persons who traveled in the area such as August Krohn (1803–1891) and Amandus Philippi (1808–1904). More substantial contributions were made by scientists who had academic positions that were located at appropriate places near the shore. Naples was a particularly active center of investigation, all the more so after the founding of the Zoological Station by Anton Dohrn. A major specialist on the group, Salvatore Trinchese (1836–1897) was influential in both research and teaching. Both he and his students occupied "tables" at the Station. French scientists did not work at the Station, but they had their own institutions. A good example is Albert Vayssière (1854–1942), who held academic positions at the University of Marseille and was active in research there for many years.

In recent years, scientists of many nationalities have been involved in studying the opisthobranch fauna, and the Portuguese and Spanish provide an instructive example. The Portuguese and Spanish tradition in opisthobranch taxonomy began in the latter part of the 19th century, but then languished for many decades during the Spanish Civil War and Franco era. The study of Iberian opisthobranchs underwent a renaissance in the 1970s and has come into full flower in the last decade. Resident workers are actively working on the fauna, training students, and developing an enduring tradition of systematic and phylogenetic study that is international in scope and impact.

The result of many years of study has been the establishment of a well-documented inventory of the opisthobranchs of the Mediterranean. On the basis of such lists, it is possible to document many trends in the investigation of the fauna and better to understand the results. The number of names introduced provides an index of such phenomena as the amount of research effort. The number of synonyms provides one way of assessing the quality of systematic work. In addition, it is possible to document changes in the composition of the fauna due to such phenomena as introduction of alien elements. Today, opisthobranchs play an increasing important role in studies of physiology, ecology, and evolution.

In traditional classifications, the gastropod mollusks have been divided into three subclasses: Prosobranchia, Opisthobranchia, and Pulmonata. The names derive from the respiratory apparatus:

prosobranchs have their gills in front, opisthobranchs have gills displaced toward the rear, and pulmonates have lungs. As a general rule, prosobranchs and opisthobranchs are marine animals, whereas pulmonates are largely freshwater and terrestrial. Only the latter two groups have been shown to represent probably monophyletic, natural groups, whereas the prosobranchs are an amalgamation of members of several distinct clades and are paraphyletic. All three groups include both snails, with well-developed shells, and slugs, in which the shell is reduced or absent, at least in the adults. But the large and beautiful marine shells that are so attractive to shell collectors are almost all "prosobranchs." Opisthobranchs are mostly slugs, and when shells are present they are either not very conspicuous or, more often, are internal. This has two important consequences: the majority of opisthobranchs are not of much interest to shell collectors, and the systematics is based almost entirely on the anatomy of soft parts. Opisthobranchs are often colorful, have considerable aesthetic appeal, and receive much attention from underwater photographers and scuba diving enthusiasts. Opisthobranchs tend to be studied by people who specialize in the group, using different approaches, techniques, and methodologies than those employed by taxonomists who focus on shelled mollusks. Among those who do study opisthobranchs, there is a similar division between those scientists who work on the half-dozen benthic orders and those who work on the two pelagic ones ("pteropods"). Additionally, the taxonomy of many of the opisthobranchs with external shells is less precise because variation in conchological features is often not consistent with well-studied anatomical variation and is often studied by different practitioners.

Much of the traditional systematics of opisthobranchs has been studied from preserved material in collections. If more comprehensive faunistic work is to be undertaken, however, the material needs to be collected systematically and, preferably, by a specialist who is collecting and studying material that was documented while alive. This means spending extended periods of time in the field, something that is easier for those who work at an institution near to where the animals occur and where it is relatively easy to keep them alive long enough to study them. From a European perspective, the Mediterranean opisthobranch fauna is a good sample of warm-water marine opisthobranchs in general, and naturalists seeking new species and higher taxa have often made excursions there.

For biology in general, opisthobranchs have become important study organisms for two quite different reasons. First, some have nervous systems that make them excellent subjects for experimental neurophysiology. Beginning in the 1960s, members of the genus *Aplysia* in the order Anaspidea became a "model organism" (Kandel 1979). Second, many opisthobranchs contain chemicals that are thought to defend them from predators. The toxicity of some of these animals was known to the ancients. For instance, Romans used them to kill people (Caprotti 1977). However, modern interest in the secondary metabolites of opisthobranchs, stimulated in part by the search for "drugs from the sea," only dates from around 1960. Work on the evolution of chemical defense in opisthobranchs developed somewhat later (Faulkner and Ghiselin 1983). The Mediterranean fauna has played a large role in these endeavors, partly due to its proximity to important laboratories and scientists, and partly because it has a good representative sample of the group.

Our discussion of research on opisthobranchs consists of three major parts. First, we consider a few scientists who made major contributions to the study of the systematics of the group mainly in the 19th century but continuing into the early part of the 20th century. Second, we take a close look at more recent developments, focusing primarily on Portuguese and Spanish contributions. Lastly, we present a quantitative analysis of the development of our knowledge of the group, based on the literature. Obviously, such a treatment does not provide a thorough, much less complete, coverage. Our aim, however, is to provide a representative sample and some interesting case studies.

Part I. The Early Investigators

Itinerant Investigators

Much of the 19th century investigation of the world fauna of opisthobranchs was carried out as part of expeditions that brought back specimens that were deposited in museums and described by specialists. There were also travelers who worked mainly on shore. The Mediterranean was a popular place for shore-based zoological explorations (Groeben 1996, 2008). It was fairly easy to get to and usually contained a rich assemblage of warm-water animals that were largely undescribed or at best little known. Two such "scientific tourists," both of whom spent long periods in the Mediterranean, partly for health benefits, were August David Krohn (1803–1891) and Amandus Philippi (1808–1904) (Groeben 1996). Both published on a wide variety of marine animals, and both described just a few species of opisthobranchs (Krohn 1847; Philippi 1839, 1841). Krohn also worked on pteropod development and on the shell and larvae of *Gastropteron* and the abberrant nudibranch *Mnestra*. Philippi, who was born in Charlottenburg, near Berlin (McLellan 1927), after finishing his doctorate in medicine in 1830, went on his first excursion to Italy. For his first major publication, *Enumeratio Molluscorum Siciliae* (Philippi 1836), he was awarded a gold medal by Fredrich Willhelm II of Prussia. He became a professor at Cassel, but was forced out for political reasons and immigrated to Chile where he became a professor and director of the National Museum.

Resident Investigators

Scientists who resided at or near the shore had the advantage of various amenities, including laboratories, museums, and libraries. In Naples, for instance, there exists a long tradition of research on marine animals, including opisthobranch gastropods. The father of this tradition was Giuseppe Saverio Poli (1746–1825). Poli was born at Molfetta and had his university education in medicine and natural sciences at Padova. He soon gave up medical practice and traveled extensively, finally settling in Napoli. He occupied the chair of physics at the Royal Military Academy beginning in 1776, then, after a period abroad, occupied various academic posts, including that of tutor to the future Francis I. He was well connected and fostered patronage of the sciences. Although he was an eminent physicist and the author of works on various scientific topics, the work of greatest interest us in this study is his *Testacea utriusque Siciliae eorumque anathome tabulis aeneis*. This work, to which he devoted about a dozen years of research, was not complete at the time of his death. The latter parts came out posthumously, edited and supplemented by Stephano delle Chiaje (1794–1860). The work is remarkable for its beautiful and accurate anatomical drawings. Although largely on bivalves, it does treat some opisthobranchs, including pteropods and a few cephalaspideans.

Academic chairs at Napoli continued Poli's tradition. There was a zoology chair associated with a *Museo Zoologico*, established in 1813, and a chair of comparative anatomy associated with a *Museo di Anatomia Comparata* was established in 1861. Oronzo Gabriele Costa (1775–1849) occupied the zoology chair from 1832 to 1839 and his son Achille Costa (1823–1867) occupied it from 1860 to 1898. The elder Costa was author of a catalog of "testacea" of the kingdom (O. Costa 1829) (Battaglini 1991). The younger Costa described a number of pteropods, nudibranchs and sacoglossans (A. Costa 1865, 1869).

The chair of comparative anatomy was first occupied by Paolo Pancieri (1833–1877) from 1861 to 1877 (see Gasco 1878; Borelli 1991). Although Pancieri was more of a comparative anatomist than a descriptive systematist and did little work on opisthobranchs, he is noteworthy for having discovered that these and other gastropods secrete sulfuric acid (Panceri 1869).

Panceri died on 11 March 1877 and was succeeded by Salvatore Trinchese (1836–1897), who began teaching in 1880 and continued to occupy the chair until 1897. There is an excellent anthology of Trinchese's malacological works with authoritative commentary (Cimino 1989 and chapters therein by Stomeo, Cimino, and Cattaneo-Vietti) from which much of our information is drawn. Born at Martano, in the province of Lecce on 4 April 1836, Trinchese graduated in medicine at Pisa in 1860. He was then awarded a fellowship to study abroad. At Paris, he was associated with Émile Blanchard, Claude Bernard, and Henri Milne-Edwards. He became an accomplished microscopist and began publishing on molluscan nervous systems. In 1865, he was invited to Genova, where he remained until 1871, when he relocated to Bologna. While at Genova, he continued his work on molluscan nervous systems. He produced magnificent descriptions of opisthobranchs, notably eolid nudibranchs, and provided valuable contributions to their anatomy and embryology. For his work on the aeolids of the port of Genova, he was awarded a prize by the Accademia dei Lincei in 1879. In 1880, he was called to Naples where he continued his researches on opisthobranchs and became a very influential teacher. At the time of his arrival in Naples, the Zoological Station, founded by Anton Dohrn around 1872, was already flourishing. It provided excellent opportunities for young Italian zoologists, many of whom later became quite eminent (Groeben and Ghiselin 2001). These included students of Trinchese and Costa. The Italian and Neapolitan governments funded quite a number of "tables" — in effect grants in support of investigators — and these were used by many of the local students. Trinchese himself occupied a table at the Station most of the time from 12 August 1886 to 31 December 1896.

One of Trinchese's students, Giuseppe Mazzarelli (1870–1946), became a important authority on the systematics, evolution, and general biology of opisthobranchs. Even in his youth, he was an enthusiastic evolutionist and published philosophical papers while still in his teens. Not surprisingly, therefore, he tended to focus on problems of comparative anatomy, especially those of organisms of particular interest to phylogenetics, that is those thought to have primitive characters or to be of problematic position. He emphasized one group, the Anaspidea or "sea-hares," and produced a large monograph on them. This was not, however, a part of the official monograph series of the Zoological Station. Mazzarelli began occupying tables while still a student and was closely associated with the Station thereafter, even when he was a professor at Milan and Palermo. After his retirement, he returned to Naples, where he died shortly after the Second World War.

Quite a number of scientists who spent time at the Zoological Station before the First World War contributed to various aspects of the biology of opisthobranchs. However, their interests were almost exclusively in comparative anatomy, comparative embryology, and functional anatomy, as was fashionable at the time. Few worked on the systematics of opisthobranchs, but there was one important exception. This was [Ludwig Sophius] Rudolph Bergh (1824–1909) of Copenhagen, a physician, who worked at a hospital there but found time to do an enormous amount of opisthobranch systematics, based largely on expedition material from all over the world. He also was in Naples in May of 1880 and May of 1883, and although he published in the Station's house organ, he did not occupy a table during these earlier stays (Bergh 1893). Indeed, it was not until 1898, from February 8 to May 4, that he finally occupied a table at the Station. Irrespective of the matter of occupying a table, his visits to the Station allowed him to supplement his work on preserved material with observations of the living organisms. According to Vayssière (1910), Bergh traveled extensively in Europe and visited Dohrn almost every year.

Although the Zoological Station was intended to be an international laboratory, it was not utilized by French scientists prior to the First World War largely because of bitterness about the Franco-Prussian War. French investigators founded their own laboratories. Actually, their traditions were well established by that time. Antoine Risso (1777–1845) was a professor at the Lycée in

Nice. He was inspired by the work of Cuvier and included a substantial amount of material on opisthobranchs in his four volume *Histoire Naturelle des Principales Productions de L'Europe Méridionale et Particulièrement de celles des Environs de Nice et des Alpes Maritimes* (Risso 1826). He also did some descriptive taxonomy (Risso 1818).

Among French zoologists who studied opisthobranchs during the late nineteenth and early twentieth centuries, the most distinguished was Albert Vayssière (1854–1942), a student of Antoine Fortuné Marion. Vayssière's son, Paul, wrote a brief biography that has been the major source of information for this essay (P. Vayssière 1975). Albert Vayssière was born at Avignon on July 8, 1854. He spent his academic career at Marseille, where he died on January 13, 1942. Although his main interest was malacology, he was also an entomologist. His doctoral thesis was on insects (Vayssière 1882), and he was involved in agricultural entomology. He became a preparatory assistant in the zoological laboratory at the University of Marseille in 1873 and subsequently was advanced to higher-level academic positions. These included the directorship of the Laboratoire d'Endoume. Vayssière's research focused on opisthobranchs, mainly on the local fauna in the Gulf of Marseille and the surrounding area. He often collected at Cary-le-Rouet, some twenty kilometers from Marseille. The local fishermen brought him material brought up in their nets, and he put it to good scientific use. One of these uses was the investigation of the functional and comparative anatomy of a wide range of opisthobranchs, leading to a better understanding of their general biology and phylogenetic relationships. Of course, he also did a considerable amount of descriptive work. Another outcome of his studies was a better understanding of the biogeography and ecological distribution of opisthobranchs and other invertebrates. He compared the French Atlantic and Mediterranean faunas (Vayssière 1900). The Atlantic organisms were mostly northern forms, and these tended to be abundant farther to the north. The Mediterranean forms were southern animals, more common in the Gulf of Naples and the coasts of Sicily and Algeria than along the French Atlantic coast. Detailed analysis of his collection data from Marseille allowed him to document local assemblages and to explain the differences among them in terms of such influences as currents and larval dispersal (Vayssière 1920).

The Second Half of the 20th Century

One of the most important contributors to the knowledge of the Mediterranean opisthobranchs during the second half of the 20th century has been Luise R. Schmekel (b. 1935). She began working at the Naples Zoological Station in 1963. In 1976, she moved to the University of Münster (Germany) as professor of Zoology. She visited the Laboratoire Arago in Banyuls-sur-mer (France, Mediterranean) several times as well as the Zoological Station to collect opisthobranchs, focusing on the Sacoglossa and Nudibranchia. From 1965 to the present, Schmekel described two new genera of aeolid nudibranchs, 11 new species of aeolid and dendronotid nudibranchs and, most recently, nine new species of the cephalaspidean genus *Runcina*. Her most significant contribution to the Mediterranean opisthobranch fauna is the book *Opisthobranchia des Mittelmeeres: Nudibranchia und Saccoglossa* (1982), in collaboration with Adolf Portmann. This volume, which is based on sacoglossans and nudibranchs from the Gulf of Naples, provides valuable information on the external and internal anatomy and ecology of many Mediterranean species. Moreover, Schmekel studied many nudibranchs species from the histological point of view. In fact, she was the first to use transmission electron microscopy extentsively to investigate opisthobranchs in order to describe and understand the arrangement and function of their reproductive systems. She was also the advisor of Heike Wägele's doctoral thesis (1987). And, although she retired in 2000, she continues to study opisthobranchs (Schmekel and Cappellato 2001, 2002).

PART II: THE STUDY OF THE OPISTHOBRANCHS FROM THE IBERIAN PENINSULA: THE AMAZING CASE OF SPAIN AND PORTUGAL.

The first published reference of an opisthobranch species from Spain was the work of Henri de Lacaze-Duthiers (1859), with a monograph about "le pleurobranch orangé" (as *Pleurobranchus aurantiacus*), based on specimens collected from the Balearic Islands. No additional records were published until 45 years later when some shelled opisthobranchs were reported from the northeastern Spanish coast (i.e., Bucquoy et al. 1886; Carus 1889–1893; Vayssière 1898, 1901, 1913; Pruvot 1901; Maluquer 1904–1916; Chia 1911–1913; Sama 1916). Together these records added 10 to 15 species to the known fauna.

In Portugal, at the end of the 19th century, Paulino d'Oliveira (1837–1899) published the first account of opisthobranchs from mainland Portugal (1895), reporting on 14 species, including the description of one new species, *Doriopsilla pelseneeri*.

Joaquín González-Hidalgo y Rodríguez (M.D.) (1839–1923), the most important Spanish malacologist during the last third of the 19th and first quarter of the 20th centuries, provided the first significant account of molluscs (land, freshwater and marine) from the Iberian Peninsula and Balearic Islands. His most important contribution in relation to the Ibero-Balearic region is included in the second part (1890–1913) of his large malacological series *Obras Malacologicas de J.G. Hidalgo*. The results of his studies concerning the marine molluscs of this region are summarized, but then updated in his subsequent *Fauna Malacológica de España, Portugal y las Baleares. Moluscos Testaceos Marinos* (1917). Nevertheless, his contribution to the knowledge of the opisthobranch molluscs from the Ibero-Balearic region was not very important because it was limited to conchological description of shelled species. We note that in his 1917 contribution, Hidalgo recorded 54 species of opisthobranchs along the Mediterranean coasts of the Iberian Peninsula and the Balearic Islands, but he did not describe any new species. Furthermore, 28 unshelled opisthobranchs species from the northern Iberian coasts, that were not included in his 1917 paper, were recorded by him in a shorter publication, which appeared a year earlier, in 1916.

With respect to the Portuguese opisthobranch fauna, Hidalgo's papers of 1916 and 1917 added 23 species to Oliveira's contribution (1895). Two decades later, the Portuguese malacologist Augusto Nobre (1865–1946) published two papers (1936, 1938–40) dealing with the marine molluscs from mainland Portugal, that included seven additional species beyond those previously recorded by Hidalgo. Scattered records of additional species from the Portuguese coasts were published during the following 50 years, until publication of a paper by García-Gómez et al. (1991) that dealt with the opisthobranchs collected during a field expedition organized by the Museum National d'Historire Naturelle of Paris in 1988 along the southern mainland Portugal coasts.

During the first half of the 1970s, the study of the opisthobranchs from the Ibero-Balearic region (mainly from Spain) underwent a fundamental transformation. Siro de Fez's (M.D.) research, based on material he collected between 1943 and 1947 from Valencia Harbour, was published in 1974, almost seven years after his death, in his book titled *Ascoglosos y Nudibranquios de España y Portugal*. Also during the early 1970s, Joandomenèc Ros started his doctoral research. His thesis, *Opistobranquios (Gastropoda, Euthyneura) del Litoral ibérico. Estudio faunístico y ecológico*, was defended at the University of Barcelona at the end of 1973. Most of the results of this thesis were then published in 1975. In 1976, Ros published the first checklist of the opisthobranchs from the Iberian coasts (but including Balearic and Canary Islands). Although no new species were described, 258 species were cited. Other contributions by Ros included several papers about the role of color in opisthobranchs (Ros 1976a, 1984) and on the development and bionomic strategies of the opisthobranchs (Ros 1981).

What led Ros to study the opisthobranchs? According to him, the reason was simple. It lay in the beauty and the shapes that he saw while diving in 1965. Later, he discovered that nobody had yet studied them in Spain (Fez's book was published after the defence of Ros' doctoral thesis). He noted that such beautiful colors were a manifestation of complicated defensive systems. For this reason, in addition to the faunistic study, ecological and ethological studies were added. Much earlier, his supevisor, Ramón Margalef, had imprinted on his doctorate students that doctoral theses should have a double objective: a faunistic/taxonomic study and an ecological one (Ros, pers. comm.).

Other Spanish malacologists followed Ros' lead in the mid- and late 1970s. Their doctoral theses focused almost exclusively on opisthobranchs. Thus, in a period of five years, Jesús Angel Ortea (University of Oviedo, 1977), Manuel Ballesteros (University of Barcelona, 1980) and Victoriano Urgorri (University of Santiago, 1981) defended their doctoral theses. The geographical area covered by Ortea and Urgorri, respectively, was the Asturian and Galician coasts (north-northwestern Iberian Peninsula, Atlantic), whereas Ballesteros focused on the Catalonian and Balearic coasts (both Mediterranean). Beyond the many records of known species of opisthobranchs, these authors have also described several new valid species from their "early" research: Ortea (6), Ortea + Bouchet (1), Ortea + Ballesteros (2), Ortea + Llera (1), Ortea + Urgorri (4) and Urgorri + Cobo + Besteiro (1). After completing their respective theses, the three authors have continued doing research on opisthobranchs, with Ortea being the most prolific student of opisthobranch systematics, while Ballesteros and Urgorri focused on problems in other areas such as benthic ecology. In the early 1980s, Ortea expanded the geographical focus of his opisthobranch research to the Canary Islands, and later to the Cape Verde Archipelago, then Cuba and the Caribbean coast of Costa Rica, becoming a prolific author of the opisthobranchs of all of these regions. Moreover, Ortea collaborated with Guido Cimino and Cimino's team from the Istituto per la Chimica di Molecole di Interesse Biologico, now renamed as Istituto di Chimica Biomolecolare in Pozzuoli (Naples, Italy). On the other hand, Ballesteros has continued with different contributions to the opisthobranch fauna from the northeastern coast of the Iberian Peninsula and the Balearic Islands, as well as his collaboration for more than 15 years with Guido Cimino and his team. This collaboration has been extended to the Antarctic opisthobranchs as well.

Urgorri had to set aside his opisthobranch studies in the mid-1980s, but he took them up again in the late 1990s in collaboration with several young Portuguese malacologists.

In the early 1980s, more young Spanish Ph.D. students, also malacologists and colleagues of Ortea, Ballesteros, and Urgorri, defending their doctoral theses in the first half of the decade: José Templado (University Complutense of Madrid, 1982), Ángel Antonio Luque (University Complutense of Madrid, 1984) and José Carlos García-Gómez (University of Seville, 1984). The first two of these doctoral theses did not involve opisthobranchs exclusively but included other gastropods. Templado's thesis focused on the southeastern coast of the Iberian Peninsula (Mediterranean) whereas Luque dealt with part of the southern Iberian Peninsula coast (mainly Granada and Malaga Provinces). García-Gómez's thesis focused largely on the Strait of Gibraltar, although it also included some sampling from along the southwestern Iberian Peninsula (Atlantic). Templado's thesis did not add new taxa, whereas Luque added one new species of opisthobranch and García-Gómez's added four more. In the meantime, the beautiful photographs of sea slugs taken by García-Gómez caused three other students from the University of Seville to "fall in love" with opisthobranchs, and they decided to do their doctoral theses on them as well. Their theses were defended during the second half of the 1980s: Antonio Medina (1986), Francisco José García (1987), and Juan Lucas Cervera (1988), leading to the establishment of the University of Seville as one of the stronger centers for opisthobranch research in Europe. Nevertheless, only Cervera's thesis focused

on faunistics and taxonomy of opisthobranchs. The other two dealt with, respectively, the histology of the gonads and gametogenesis of one species of nudibranch and the functional anatomy of three other species. The geographic area covered by the Cervera's thesis was southwestern Andalucia (Atlantic) and the Strait of Gibraltar and added six new valid species of opisthobranchs. In 1989, Juan Lucas Cervera moved to a temporary position at the University of Cadiz; two years later, the position became permanent. In September 2007, Francisco Jose Garcia was advanced to full Professor at the University Pablo de Olavide, which, like the University of Seville, is also in Seville.

Meanwhile, in 1981, Joandomenèc Ros was appointed Aggregate Professor at the University of Murcia (southeastern Iberian Peninsula). Although he returned to a full professorship at the University of Barcelona in 1986, he advised the doctoral thesis of Arnaldo Marín at the University of Murcia. In 1988, Marín defended his thesis, which focused on the "symbiosis" of the chloroplasts in Sacoglossa and the association of zooxanthellae with several nudibranch species, adding information about the diversity of opisthobranchs along the southeastern coasts of the Iberian Peninsula. However, he did not describe any new taxa in his thesis. Marín now has a permanent position at Murcia. He has continued doing research in this field, but currently most of his current research is not related to opisthobranchs. On the other hand, he served as co-advisor of Claudia Muniain's Ph.D. thesis as well as advisor of those of Francisca Giménez-Casalduero and Francisco Aguado (see below), all of which were concerned with opisthobranchs.

In May of 1987, during the second Meeting of the Italian Malacological Society held in Sorrento (Italy), Ros, Ortea, Ballesteros, García-Gómez, Templado, García, Cervera, and Marín met Guido Cimino, the leader of the team of organic chemists and biologists at the Istituto per la Chimica di Molecole di Interesse Biologico in Arco Felice (Naples) who were studying natural products from marine invertebrates. This meeting was both important and productive because it led to the collaboration between Spanish biologists and malacologists and the Italian chemists. This cooperation offered the opportunity for studying opisthobranchs from a different point of view, namely the chemical ecology of opisthobranchs, and resulted in several Ph.D. theses done in Spain during the 1990s (see Conxita Ávila, Luis Ángel Álvarez-Orive, Eugenia Martínez, Francisca Giménez-Casalduero, Francisco Aguado). Indeed, Cimino became one of the supervisors of Avila, Alvarez-Orive, and Martinez' Ph.D. theses. The collaboration continues to the present day.

The additions to the knowledge of the Iberian opisthobranch fauna by most of the above Spanish researchers led to the compilation of an updated checklist of the opisthobranchs of this geographical area, which included the Canary Islands and the African side of the Strait of Gibraltar, thus replacing Ros' checklist of 1976 . Because the new checklist includes taxonomic remarks, this revision was more useful than the earlier list. Also, the new list, which was completed by Cervera et al. in 1988 (*Iberus*, supl. 1:1–84), includes 389 opisthobranchs species, in contrast to the 258 species of the Ros' checklist (N.B. some taxa included in the 1988 checklist are now considered synonyms or of dubious status).

A change of focus with respect to the study of the opisthobranchs occurred in Spain during the 1990s. Thus, a new generation of young Ph.D. students focused on the systematics of opisthobranch higher taxa without restriction to the Iberian littoral: Eugenia Martínez (1995, Anaspidea of the NE Atlantic, including a section on their chemical ecology; no new taxa described) and Ángel Valdés (1996, Atlantic Porostomata nudibranchs; five new species and two new subspecies). Both were students of Ortea at the University of Oviedo. Other aspects of comparative biology were studied, such as the chemical ecology of opisthobranchs: Conxita Ávila (1993, University of Barcelona) and Luis Ángel Álvarez-Orive (1994, University of Seville), and feeding and defensive ecology in opisthobranchs by Francisca Giménez-Casalduero (1997, University of Murcia), Fran-

cisco Aguado (2000, University of Murcia), and César Megina (2000, University of Cádiz), now Ph.D. assistant at the University of Seville. During the first years of the 21st century, the trend that started in the 1990s has continued, although some doctoral theses were more traditional, such as that of Luis Sánchez Tocino (2003, University of Granada) on the Doridoidea from the coasts of Granada (southern Iberian Peninsula, western Mediterranean; some unidentified species are probably new) and Manuel Caballer Gutiérrez (2007, University of Cantabria) on the opisthobranchs from the Bay of Santander, with a review of several genera of sacoglossans and aeolids. Thus, research for doctoral theses focused on the molecular phylogeny of opisthobranchs (Cristina Grande, 2004, Museo Nacional de Ciencias Naturales of Madrid-CSIC), reproductive biology of several species of nudibranchs (Inés Martínez-Pita 2005, University of Seville), and the systematics of a dorid subfamily (Marta Pola, 2006, University of Cádiz, who described 11 new species from outside the Iberian Peninsula).

Additionally, Jesús S. Troncoso arrived from Brazil at the University of Santiago in 1985. He carried out his doctoral thesis research under the supervision of Victoriano Urgorri. His thesis (1990) was not concerned with opisthobranchs but focused on the faunistics and ecology of benthic molluscs from part of the Galician littoral. However, during the 1990s, he joined Francisco J. García, José Carlos García-Gómez, and Juan Lucas Cervera and commenced a study of the Antarctic opisthobranchs that had been collected by several Spanish benthic expeditions to Antarctica. At the end of the 1990s, together with Francisco J. García, Troncoso instituted a series of expeditions to Brazil to collect opisthobranchs at several localities in the states of Noronha, Pernambuco, Bahia, Rio de Janeiro, São Paulo, and Santa Catarina. Troncoso also participated in an expedition to the Pacific coast of Panama. Some of the results these efforts have been published during the last seven years (García and Troncoso 1999, 2001). In 1995, Troncoso moved from the University of Santiago to the University of Vigo, both in northwestern Spain. And, in 2007, Marta Domínguez (University of Vigo) defended her doctoral thesis, a faunistic study of opisthobranchs from Brazil, which was done under the supervision of Troncoso and F.J. García.

Not only Troncoso, but also several others moved from their original universities some time after they received their Ph.D. degrees. Thus, in 1996, Ángel Valdés went to the Muséum National d'Histoire Naturelle in Paris as *Chercheur Invité*, and the next year he relocated to the California Academy of Sciences (San Francisco) as postdoctoral fellow. In 2001, he accepted a position of Assistant Curator at the Natural History Museum of Los Angeles County and more recently a position as Associate Professor in the Department of Biology at California State Polytechnic University in Pomona, California.

Following the defense of her doctoral thesis, Conxita Avila held a two-year postdoctoral fellowship at Woods Hole (Massachusetts, USA) before returning to Spain as a "Ramón and Cajal" Researcher in Centro de Estudios Avanzados (CSIC) of Blanes (Gerona, Catalonia, Spain). Avila also spent short periods at the Marine Laboratory of the University of Guam (Micronesia, USA) and the Alfred-Wegener Institute for Polar and Marine Research (Bremerhaven, Germany). In January 2007, she joined the staff of University of Barcelona (Spain). Currently, her research focuses on chemical ecology of marine benthic invertebrates, not just opisthobranchs.

Luis Angel Álvarez-Orive left the University of Seville and ceased doing research in 1997 after being hired by an environmental monitoring company. Francisca Giménez Casalduero moved to the University of Alicante at the end of the 1990s, where she now holds a permanent position. Cristina Grande received a postdoctoral fellowship in 2005 at the University of California, Berkeley (California, USA) to conduct research on lower heterobranchs. Finally, Marta Pola is currently at the California Academy of Sciences (San Francisco) on a postdoctoral fellowship to work on systematics of nudibranchs as part of Terry Gosliner's research team.

Only scattered records of additional species from the Portuguese coasts were published by different authors during 50 years after Nobre's contribution, in May-June 1988.

Finally, in 1988, during the months of May–June, the Muséum National d'Histoire Naturelle of Paris organized a field trip that ventured along the southern coast of mainland Portugal. Although some new or uncommon opisthobranch taxa were described from materials collected during this trip in the early 1990s, the important contribution was the paper by García-Gómez et al. (1991) in which they reported on 84 species of opisthobranchs of which 53 were new additions to the Portuguese marine fauna. These data show how poorly known the Portuguese opisthobranch fauna was.

During the early 1990s, two young undergraduate Portuguese malacologists, Gonçalo P. Calado and Manuel Antonio E. Malaquias, expressed an interest in opisthobranchs. Thus, they contacted known Spanish specialists, namely Victoriano Urgorri and Juan Lucas Cervera, hoping to learn more about these animals. As a result of these contacts, especially during the latter half of the 1990s, Calado decided to attend the University of Santiago to undertake his doctoral thesis, which he defended in 2001, on the taxonomy and biology of the poorly known aeolid genus *Calma*. A new and cryptic species of this genus was described from this thesis (Calado and Urgorri 2002).

Malaquias defended his M.Sc. thesis on the taxonomy and ecology of *Haminoea* in Portugal at the University of Coimbra, in 2003. He since has completed his Ph.D. thesis on the systematics of the genus *Bulla* at the Natural History Museum of London (NHM) through the University of London (Queen Mary's College), held a Postdoctoral Fellowship at the NHM and was a Postdoctoral Fellow in the Museu Nacional de História Natural da Universidade de Lisboa. Currently, he holds the position ofProfessor of Invertebrate Systematics at the Bergen Museum, University of Bergen (Norway). The above cooperation has permitted the increase of the knowledge of the opisthobranch fauna in Portugal and resulted in the publication of several papers over the last seven years.

After the many contributions and additions to the opisthobranch fauna of Spain and Portugal during the 1990s and early 2000s, several Spanish and Portuguese authors considered it desirable to publish a new, updated, annotated checklist of the opisthobranchs from Spain and Portugal, including the Balearic and Canary Islands, as well as Madeira, Selvagens, and Azorean Archipelagos. This checklist, which was published by Cervera et al. (2006 [2004]), includes 523 species. This is a revised version of a checklist originally published in 1988, and many of the new additions to the 2006 list were due to the extension of the study to Madeira and the Azores, as well as to the large number of contributions concerning the Canary Islands. With respect to the Canary Islands, the number of species known from this archipelago increased from 93 to 252. Also remarkable is the increase of the species recorded from mainland Portugal, from 91 to 213 in the most recent checklist. From 1974 to date, Spanish opisthobranch workers have described one genus and 89 valid species of opisthobranchs for the Ibero-Macaronesian area, but only nine are known only for the Mediterranean. The remaining ones are known both for the Atlantic and Mediterranean coasts or have been recorded in Atlantic waters only.

Finally, the of richness of the opisthobranch fauna from Spain and Portugal in comparison with the whole European coasts can be seen when one compares the 523 species considered by Cervera et al. (2006) with of the 664 species included in the *European Marine Register of Species* (Costello et al. 2001).

There is also a remarkable recent trend in the Opisthobranch "Spanish School." This is in its participation in the education and training of several international malacologists who have come to Spain to study opisthobranchs. As mentioned above, several young Portuguese biologists have studied opisthobranch mollusks under the guidance of established Spanish researchers. Thus.

Urgorri was one of the supervisors of Calado's doctoral thesis and Cervera was one of the advisors of the Malaquias' Master's thesis. However, such interactions have crossed the Atlantic reaching Argentina and Chile, two countries without active experts on opisthobranchs. In 1993, two young postgraduate students, one Argentinian, Claudia Muniain, and one Chilean, María Angélica Fischer, arrived at the University of Oviedo to carry out their doctoral studies on opisthobranchs that occur in their respective countries. Claudia Muniain defended her doctoral thesis in 1997, based on research done under the supervision of Ortea and Marín and in collaboration with Cimino's lab in Naples. Muniain returned to Argentina and in 2004 received a permanent position as researcher of CONICET at the Museo de Ciencias Naturales "Bernardino Rivadavia" in Buenos Aires. María Angélica Fischer (born Muñoz Jiménez) moved from Oviedo to Germany in 1996. In 2000, Cervera became her supervisor. Her meeting with researchers from the University of Nijmegen (Netherlands) in 2003 provided additional focus and facilitated the defense of her doctoral thesis in 2006.

Can We Explain Why the Study of the Opisthobranchs Started so Late in Spain and Portugal?

To try to reply to this question, there are some circumstances to be considered:

1) Most of the opisthobranchs are small and most lack a shell or have one that is reduced. One finds new opisthobranchs on sandy beaches. Usually, they are collected by scuba or snorkelling, although they can be found intertidally as well.

2) Scuba-diving was developed during the second half of the 20th century. Moreover, during the earlier stages of development scuba was considered only as a tool for marine engineering or geology.

3) Both in Spain and Portugal, scuba-diving facilities were developing for tourism, mainly in those areas in which the sea conditions or the access from the shore permitted easy diving. This happened during the 1970s and earlier 1980s.

4) Malacology has had strong support by shell collectors but not professional researchers. Therefore opisthobranchs were largely overlooked by conchologists. This has led that to the fact that opisthobranchs have been studied largely within an academic setting, although more recently they have attracted the interest of diving photographers and other amateurs.

5). In 1871, the Real Sociedad Española de Historia Natural (RSEHN) was founded, but it was not until the second half of the 1970's when a group of mollusc lovers, undergraduate students in biology, other Spanish malacologists (professionals or shell collectors), decided to create a working group on Malacology within the RSEHN (1977). This working group started to enlarge and would become the core of the Spanish Malacological Society that would be founded in 1980, after the split from the RSEHN. During the last 27 years, one of the objectives of the new society has been the promotion and encouragement of malacological studies in Spain. The headquaters of the Spanish Malacological Society is the Museo Nacional de Ciencias Naturales (CSIC) in Madrid.

6) So-called "natural history" had its explosion during the second half of the XVIIIth and the XIXth centuries due to the growing interest in various subdisciplines, including malacology, that spread among the higher and cultured social classes of many European countries. Thus, many academies and research institutions were founded in this period, even in Spain and Portugal. For example, in 1772 the King of Spain, Carlos III, founded the Museo Nacional de Ciencias Naturales in Madrid (MNCN) (formerly called Real Gabinete de Historia Natural) which started with excellent collections and library, as well as many pieces of porcelain and paintings mainly from southern America. The history of this museum can lead us to understand the troubles of natural history and taxonomy/systematics during the last 234 years in Spain.

Thus, this museum suffered unfortunate and dramatic historical events. It was closed during the French invasion of Spain (1808–1813) and sacked in 1813 during the French occupation. It re-opended in 1814, partly with objects taken by the French army that were later returned and the activities were increased. Once again, a new dark period (1867–1900) brought to the museum essential dismemberement and destruction. In this period, Spain faced several revolutionary events, suffered several coups d'etat and changes of political regimes and finally the wars that lead to the end of the Spanish empire, the loss of Cuba and Philippines in 1898. Obviously, during this period, the politicians and society did not show much interest and financial support for natural history. In fact, in 1895 the museum was evicted, with the accumulated collections spread among two other museums. From this point, the researchers of the MNCN continued under very difficult conditions the arduous work of inventorying of all the accumulated collections and library.

From 1901, the Spanish government gained a clear understanding of the value and usefulness of a Museum of Natural Sciences. Thus, step by step, the MNCN was emerging again. A new period (1901–1936) of investment and new collections and material were acquired, to develop a national institution dedicated to preserving and documenting natural history specimens and bibliography related to the nature conservation, to the progress of knowledge by means research, and the spreading of this knowledge through exhibitions and courses. This positive change was integrated in a new wider philosophy about science and culture that brought about the creation of the "Junta para la Ampliación de Estudios e Investigaciones Científicas (JAE)" in 1907.

With this new institution, the government hoped to end the Spanish isolation and to link Spain with European science and culture, and moreover to train the staff to carry out the necessary reforms in science, culture, and education. Thus, the effort to reform and regenerate the country was considered a national matter, independent of political swings, where intellectuals of different ideologies were involved. The JAE from the beginning was presided over by Santiago Ramón y Cajal, one of the two Spanish scientists awarded the Nobel Prize (1906). Its scientific and cultural program constituted the most innovative project in Spain from 1907 to 1939, with the creation of laboratories, research centers, fellowships to study in foreign countries, etc., as well as, helping to link Spanish scientists and intellectuals with those of other countries. Together with other research centers and institutions, the MNCN was involved within the JAE. Joaquín González Hidalgo's collections of molluscs, as well as those of other malacologists, were housed in the museum during this period.

In the meantime, in 1914 the Instituto Español de Oceanografía (IEO) was founded after the integration of the marine laboratories of Santander (1886, dependent on University of Valladolid) and Porto Pi (Majorca) (1906, dependent on the University of Barcelona) into one institution. The institute was created to explore the sea and to carry out marine research at a national level, mainly to advise the Government about assessment of the marine biological resources and fisheries. At present, the IEO is addressing the multidisciplinary study of the sea, especially problems resulting from the exploitation of resources and pollution. Thus, the IEO tends to direct its efforts to applied marine sciences, and to give concrete advice to the public administration referring to the sea, with emphasis on sustainable exploitation and conservation. The IEO represents the Spanish Government on oceanographic commissions and organizations of international scope, and participates as a scientific advisor during international negotiations on fishing agreements. Therefore, the study of the opisthobranchs is outside the scope of the institute's work.

In 1936, the Spanish civil war exploded and in 1938 the JAE was eliminated together with the closure of many laboratories and research institutions, including the MNCN. Many Spanish researchers exiled themselves and continued their research out of Spain, for example in Mexico (Fig. 1).

In 1939, Franco's regime erected the Consejo Superior de Investigaciones Científicas (CSIC), which incorporated the laboratories and research center of the JAE, including the MNCN. The period of 1936–1984 was a very dark period for the museum that largely coincides with the period of Franco's regime (1939–1975). Thus, with some exceptions there were no new research positions, with few vacancies being filled. The Museum suffered grave disorder, deterioration and losses of collections.

At this point, we should mention Prof. Ramón Margalef (1919–2004), the most renowned Spanish ecologist and one of the world's most outstanding limnologists. He was the strongest promoter of Spanish biological oceanography. He was lucky to meet after the 2nd World War a talent finder from an American university who offered him an unlimited opportunity to visit several research institutions in the USA and other countries. He obtained a research position at the Instituto de Investigaciones Pesqueras (CSIC) from Barcelona (now, Instituto de Ciencias del Mar) in 1950. Years later he became the Director of this center (1966–1967) providing decisive impetus towards promotion of biological oceanography, transforming it from an applied fisheries research center into a true reference center. He also provided very strong input to the journal *Investigaciones Pesqueras* (now, *Scientia Marina*) that permitted the spread of the marine science undertaken in Spain. For many years he was the most cited Spanish scientist, and together with Santiago Ramón y Cajal and Severo Ochoa (both Nobel Prize recipients) was one of the three most relevant Spanish biological scientists, among a list of ninety-five from all around the world. He was awarded by the first the Huntsman Prize (considered as the Nobel Prize of the Sea). He was the first Full Professor of Ecology of Spain (1967) at the University of Barcelona. Margalef was indirectly related to the study of opisthobranch molluscs as he was the supervisor of Joandomenèc Ros' doctoral thesis (1973).

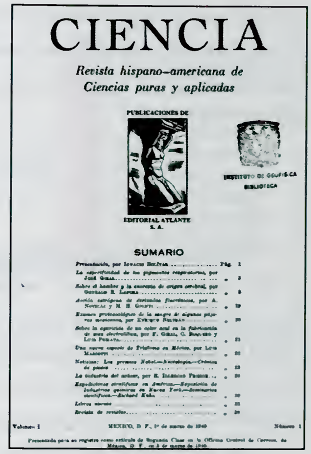


FIGURE 1. *Revista hispano-americana de Ciencias puras y aplicadas*. Edited in Mexico from 1940 for the Spanish scientists exiled in Mexico.

In 1984, the Direction of the CSIC embarked upon a profound restructuring of the MNCN. New fields of research were opened and new research and technical positions were provided. In general, a major effort was made to open the Museum to the general public, as well as to supply facilities and improvement to turn the Museum into the authority for natural history in Spain. This effort implies significant financial investment. Curiously, all this effort happened simultaneously with the definitive support from the Science and Research by the Spanish and Regional Governments. In fact, the large Fauna Ibérica project to describe the Iberian fauna and lead by the MNCN began in 1987, involving Spanish and non Spanish experts in many taxonomic groups. Even if the financial support had not been all that scientists wanted, monographs on all the studied groups are being successively published. One of these groups is the opisthobranchs. These works will be divided in several volumes.

Why Did No One Study Opisthobranchs in Portugal After Paulino d'Oliverira (1895)?

To reply to this question we should refer to the four circumstances quoted in the previous section concerning Spain, i.e., most lack a shell and are small in size, the main supporters of Portuguese malacology have been shell collectors, land or freshwater malacologists, or applied malacologists (Tropical Medicine Center), scuba-diving facilities were developed by tourism and, of

course, no strong financial support was given for natural history or taxonomic/systematics studies. Some taxonomic groups have been or are being studied by Spanish experts or by Portuguese in collaboration with Spanish experts within the project "Fauna Ibérica", opisthobranchs being one of these cases.

PART III: HISTORICAL TRENDS IN THE STUDY OF MEDITERRANEAN OPISTHOBRANCHS

The marine biota of the Mediterranean Sea is one of the most extensively studied of any region in the world. Linnaeus' earliest systematic works (1758) include many Mediterraean species. With the publication of the recent checklist of opisthobranchs from the Iberian Peninsula (Cervera et al. 2006), it is possible to combine these data with data from other recent literature to gain a quantitative picture of the opisthobranch diversity of the Mediterranean and how that diversity has been understood from Linnaean times to the present.

In compiling the quantitative list of Mediterranean opisthobranchs, only currently recognized taxa are included. Taxa with multiple synonyms, of which there are many, are indicative of the amount of systematic study that has occurred within the Mediterranean, but an historical analysis of synonyms is beyond the scope of the present analysis. Excluded from the quantitative analysis are taxa that are known to have been introduced to the Mediterranean. We, however, do address the impact of anthropogenic changes in the Mediterranean. Thus, for the purposes of this study, 537 species of opisthobranchs are recognized as naturally occurring within the Mediterranean Sea, approximately the same number as were collected in a much smaller area in northern New Guinea (536) and considerably more than were known from Hawaii (244) (Ghiselin 1993). Because the Mediterranean list represents a larger geographical area and bathymetric range, the New Guinea fauna is richer than the figures suggest.

These species are not evenly distributed within the major opisthobranch taxa (Fig. 2). There are at least three plausible explanations for the uneveness of diversity within major taxa. First and foremost, the major taxa do not represent equivalent evolutionary units. They are not all sister taxa of each other. While in traditional ranked classification they are all considered orders, they do not represent branches that diverged from a common ancestor at the same time. The older lineages have had more time to diversify. Secondly, it appears that these taxa species have evolved at different rates. Some clades have speciated far more rapidly than others. And thirdly, there may have been differences in the rates of invasion from outside the area and in extinction within it.

The Cephalaspidea, which are relatively diverse, represent one of the most basal taxa of opsithobranchs. Their morphological and ecological diversity is very high. Included within this taxon are representatives with a well developed shell, intermediates that have a reduced shell and others that have a greatly reduced internal shell. Traditionally, those with an external shell have been studied by general conchologists while those with an internal shell have been studied by specialists who have worked only with opisthobranchs. When we compare the diversity of shelled forms that were described during different periods of time (Fig. 3), it is evident that the greater percentage of externally-shelled forms were described prior to 1900, while the majority of the internally-shelled taxa have been described much more recently, particularly in the last 50+ years.

The Anaspidea are a realtively morphologically uniform group of opisthobranchs with relatively low diversity and few trophic specialists. Thirteen species are known to be native to the Mediterranean. The vast majority of species have been described prior to 1850 (Fig. 4), with only three taxa described in the last 156 years. Despite the fact that they lack external shells, most species are at least seasonally common and are large and conspicuous. Thus they have been relatively well studied for a longer period.

The Sacoglossa represent a diverse assembledge of morphological forms from shelled to entirely shelless taxa. They are well represented in the Mediterranean with 46 native species. Most are small and cryptic in their appearance. Almost all species are specialized herbivores, feeding on diverse algal prey. This diversity of prey allows for a high diversity of sacoglossans to coexist without competitive exclusion. Within the Mediterranean fauna species have been described over the entire span of systematic history and continue to be named in large numbers (Fig. 5).

Whereas most major groups of opisthobranchs are benthic organisms for the vast majority of their lifespan, two major groups are holoplanktonic, spending their entire lives as members of the plankton community. The Thecosomata are shelled and are suspension feeders. On the other hand, the Gymnosomata lack a shell and are predatory, often feeding on members of the Thecosomata. The thecosomes have a higher species diversity within the Mediterranean than do the gymnosomes (Fig. 6). Also thecosomes continue to be described in high numbers whereas few gymnosomes have been named within the last 50 years. This attests to the relatively early focus and continued interest in plankton communities within the Mediterranean by resident and visiting oceanographers.

The vast majority of opisthobranch species are members of the Nudibranchia and this is certainly the case within the Mediterranean, where more than half of the opisthobranchs are nudibranchs. They are highly specialized as to prey preferences. Within the Nudibranchia, the group with the largest number of species is the Doridina, followed by the Aeolidina, Dendronotina, and Arminina (Fig. 7).

Within the Doridina, the most diverse group of nudibranchs, two groups have traditionally been recognized, the Cryptobranchia and the Phanerobranchia. Recent phylogenetic studies suggest that Cryptobranchia is likely monophyletic while Phanerobranchia is paraphyletic (Valdés 2002; Fahey and Gosliner 2004;

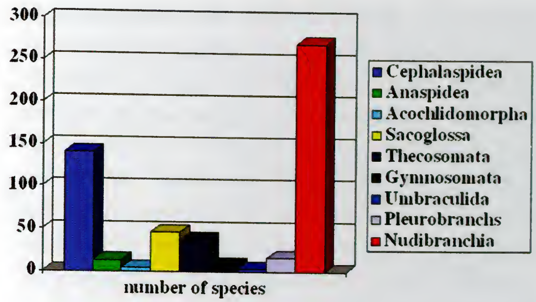


FIGURE 2. Species diversity of various opisthobranch clades found in the Mediterraean.

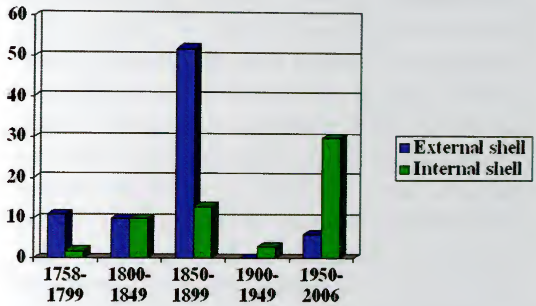


FIGURE 3. Historical differences in species description of externally-shelled versus internally shelled Cephalaspidea.

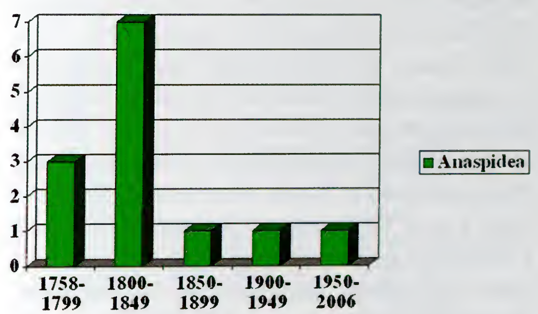


FIGURE 4. Historical descriptions of Mediterrean Anaspidea.

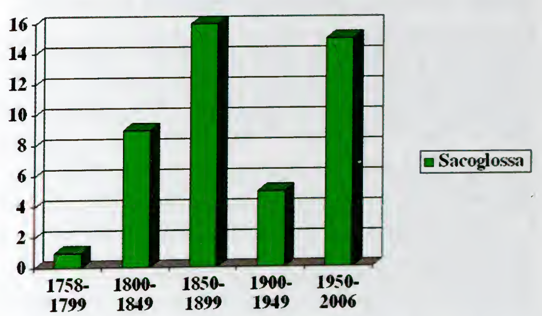


FIGURE 5. Historical descriptions of Mediterranean Sacoglossa.

Pola et al. 2007). Within the Mediterranean cryptobranchs, which are largely predators on sponges, are more diverse than "phanerobranchs" which are specialists on bryozoans and ascidians. Large numbers of species of both groups have been described in the last fifty plus years (Fig. 8). This is most likely due to the advent of scuba diving collection of species that were never encountered by intertidal collecting and trawling methods.

While the above historical patterns differ significantly between different opisthobranch taxa, with the greatest number of species being described at different periods, several general patterns emerge. In almost all cases, description of new taxa continues today and is often progressing at the highest rate since the Linnean era. Our understanding of Mediterranean opisthobranch diversity continues to grow and new taxa continue to be discovered. Another pattern that is consistent within all groups of opisthobranchs is that the period when the fewest number of species was described was between 1900–1949 (Figs. 3–6, 8). It is evident that the era including the two great World Wars took a heavy toll on systematic and biodiversity research. To personalize this point, included in this paper is a reproduction of a letter written by the French opisthobranch systematist Alice Pruvot-Fol to Dr. Frank MacFarland. MacFarland was a Professor of Biology at Stanford University and President of the Calfornia Academy of Sciences. The letter (Fig. 9), part of the MacFarland archives at the California Academy of Sciences, dated in August 1945, not only clearly states the hardships endured by Pruvot-Fol but describes the adverse impact on her scientific productivity. As a result of not being able find a seat on a train, she was unable to return to her work at the marine laboratory and was forced to conduct literature reviews rather than examine specimens and describe new taxa. It should be noted that of the 15 species of Mediterranean opisthobranchs described by Pruvot-Fol, one was described in 1937 and the balance between 1948 and 1957. Clearly, World War II profoundly impacted not only her work but all research on the Mediterranean biota.

Description of the opisthobranch diversity of the Mediterrean has spanned a long period and is far from complete, as evidenced by the many new taxa that continue to be described. Over the almost 250-year history of discovery, many systematists have contributed to our knowledge of the opisthobranch fauna of the region. The 537 species have been described by 150 distinct senior authors. Not all of these authors have contributed equally to our understanding of the Mediterranean

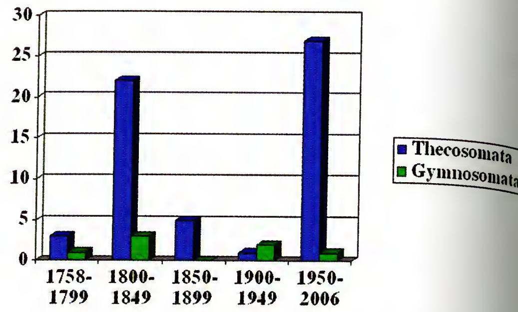


FIGURE 6. Historical descriptions of Mediterranean Thecosomata and Gymnosomata.

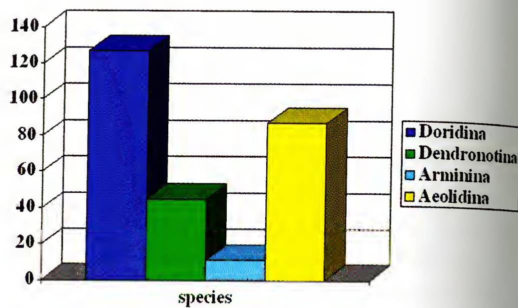


FIGURE 7. Species diversity of various nudibranch clades found in the Mediterraean.

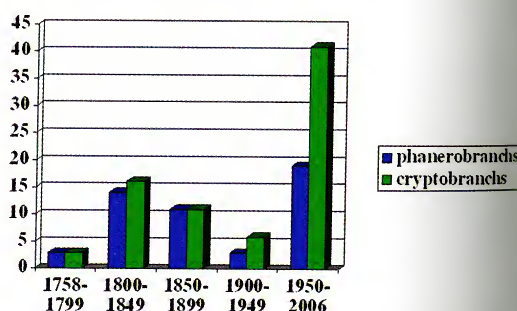
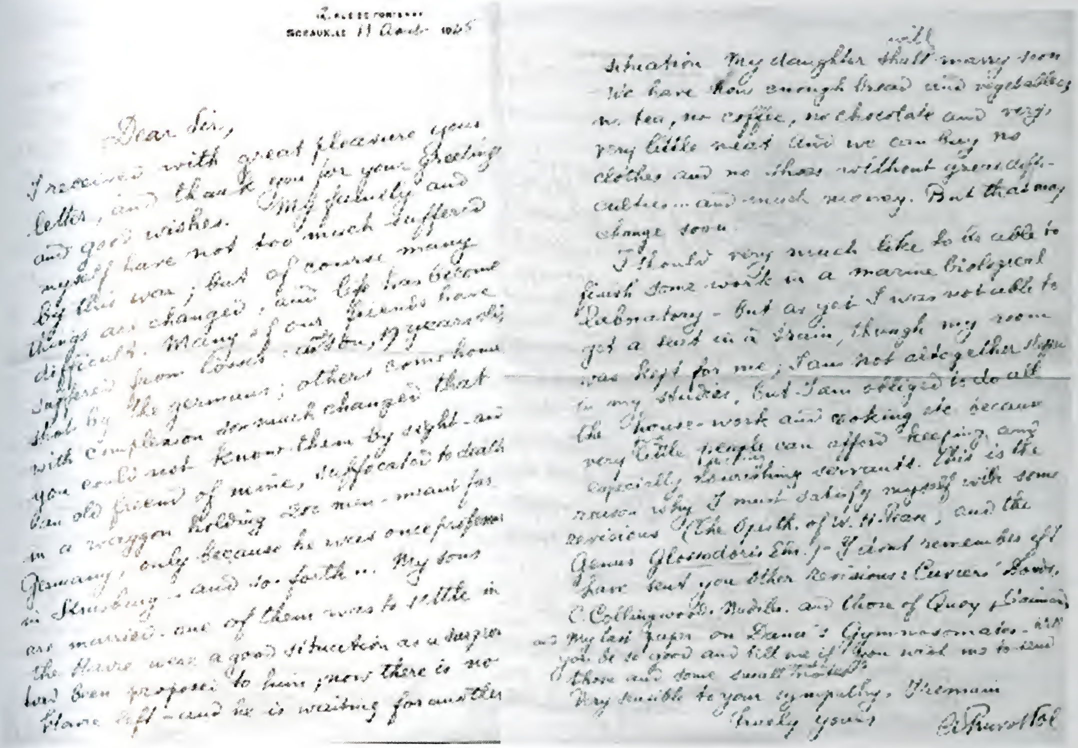


FIGURE 8. Historical descriptions of Mediterranean Cryptobranchia and "phanerobranchs"



11 Août 1945

Dear Sir,
I received with great pleasure your letter, and thank you for your greeting and good wishes. My family and myself have not too much suffered by this war; but of course many things are changed, and life has become difficult. Many of our friends have suffered from [illegible]; others come home shot by the germans; others changed that with complexion so much changed that you could not know them by sight — an old friend of mine, suffocated to death in a waggon holding [illegible] men — [illegible] only because he was once professor in Strasburg — and so forth... My sons are married — one of them was to settle in the Havre where a good situation as a surgeon had been proposed to him; now there is no Havre left — and he is waiting for another situation. My daughter will marry soon. We have now enough bread and vegetables, no tea, no coffee, no chocolate and very very little meat and we can buy no clothes and no shoes without great difficulties... and much money. But that may change soon.
I should very much like to be able to finish some work in a marine biological laboratory — but as yet I was not able to get a seat in a train, though my room was kept for me; I am not altogether stopping my studies, but I am obliged to do all the house-work and cooking etc. because very little people can afford keeping any servants. This is the reason why I must satisfy myself with some revisions (The Opisth. of W. H. Dan, and the Genus Glossodoris Ehr.) — I don't remember if I have sent you other revisions: Cuvier's Doris, Collingwood's Nudibr. and those of Quoy & Gaimard and my last paper on Dana's Gymnosomata — will you be so good and tell me if you wish me to send those and some small notes?
Very sensible to your sympathy, I remain
truly yours
A. Pruvot-Fol

FIGURE 9. Letter from Alice Pruvot-Fol to Frank MacFarland, August 11, 1945.

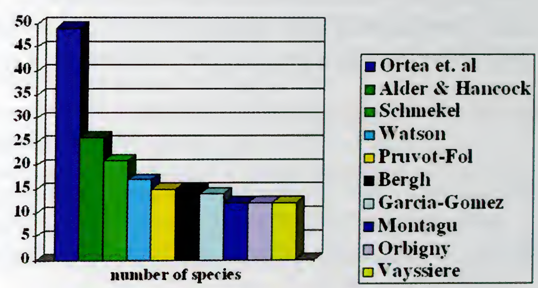


FIGURE 10. Top ten authors who have described the most Mediterranean opisthobranch species.

opisthobranch fauna. Ten authors have described a disproportinate number of the species. These individuals and the number of species they described are shown in Figure 10. Collectively, they described 193 of the 537 Mediterranean opisthobranchs or 36% of the known fauna. Four of them published most of their systematic work in the last half of the 20th century and three continue to publish to the present. This again reinforces the point that much of our current knowledge of Mediterranean opisthobranchs has been developed only recently. A combination of new collecting techniques (especially scuba and various underwater vacuuming tools) and exploration of new geographical areas such as the Canary Islands, Madeira, the coast of mainland Portugal and the northern coast of Africa have contributed to this recent and continuing discovery of novel Mediterranean opisthobranchs.

In addition to the 537 presumed native species of opisthobranchs found in the Mediterranean Sea, 21 species appear to have been introduced by human activities such as shipping and culturing of non-native species for food. Of the twenty-one species known to be introduced to the Mediterranen, 18 are known to have been allowed entry by the contruction of the Suez Canal, resulting in what is called Lessepsian migration from the Red Sea into the Mediterranean (Gofas and Zenetos 2003). Of the three remaining introduced species, one each has likely been introduced from California, Japan and South Africa. The Californian and South African species were likely introduced

by discharge of balast water while the Japanese species was most likely transported together with introduced shellfisheries from Japan.

In conclusion, the above data document historical patterns of study within the Mediterranean region. Taxonomic differences in the timing of study of different opisthobranch groups reflect different systematists studying shelled and unshelled opisthobranchs. Also evident is the difference in timing and greater apparent completeness of knowledge of common and conspicuous groups versus those that are smaller, more cryptic or inhabiting areas that require scuba diving. While introduction of non-indigenous species has added to the known biodiversity of Mediterranean opisthobranchs, clearly indigenous taxa are also continuing to be discovered, especially within the internally-shelled Cephalaspidea, Sacoglossa and Nudibranchia. This incompleteness of inventory of species of opisthobranchs found in the Mediterranean Sea, one of the best known marine regions in the world, has profound implications as to the even greater incompleteness in the knowledge of the constituent fauna of other lesser known regions. These data reinforce previous studies (Gosliner and Draheim 1996), suggesting that probably half of the world's opisthobranch taxa remain unknown. These studies of biodiversity that are largely conventional will be further impacted by forthcoming genetic studies that are likely to reveal more cryptic species. We are a long way from being able to produce comprehensive lists of opisthobranch taxa in the better known portions of the ocean, let alone in areas that are less explored.

Acknowledgments

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Literature Cited

Battaglini. P. 1991. Il contributo de Oronzio Gabriele Costa nella ricerca scientifica naturalistica italiana dell '800. *Bollettino della Società dei Naturalisti in Napoli* 98/99:171–191.

Bergh, R. 1893. Die Gruppe der Doridiiden. *Mittheilungen aus der Zopologischen Station zu Neapel* 11:107–135, Taf. 8.

Borelli, A.1991. Paolo Panceri nella Napoli del secondo ottocento. *Fridericiana* 1:93–113.

Bucquoy, E., P. Dautzenberg, and G. Dollfus. 1886. *Les mollusques marins du Roussillon. Tome I. Gastropodes*. Fascicule 13. J.B. Baillière & fils., Paris, France. 487–570 pp., pls. 61–66.

Calado, G., and V. Urgorri. 2002. A new species of *Calma* Alder & Hancock, 1855 (Gastropoda: Nudibranchia) with a review of the genus. *Journal of Molluscan Studies* 68:311–317.

Capriotti, E. 1977. Molluschi e medicina nel Io secolo d. C. (studi di malacologia perinascimantale, II). *Conchiglie* 13:137–144.

Carus, J.V. 1889–1893. *Prodomus Faunae Mediterraneae. Sive Descriptio Animalium Maris Mediterranei Incolarum quam comparata Silva Rerum quatenus innotuit adectis Locis et Nominibus Vulgaribus. Vol. II. Branchiostomata. Molluska. Tunicata. Vertebrata.* Schweizerbartsche, Stuttgart, Germany. ix + 854 pp.

Cervera, J.L., G. Calado, C. Gavaia, M.A.E. Malaquias, J. Templado, M. Ballesteros, J.C. García-Gómez, C. Megina. (2004) 2006. An annotated and updated checklist of the opisthobranchs (Mollusca: Gastropoda) from Spain and Portugal (including islands and archipelagos). *Boletín del Instituto Español de Oceanografía* 20(1–4):1–122.

Cervera, J.L., J. Templado, J.C. García-Gómez, M. Ballesteros, J. Ortea, F.J. García., J. Ros, and A.A.

LUQUE. 1988. Catálogo actualizado y comentado de los Opistobranquios (Mollusca, Gastropoda) de la Península Ibérica, Baleares y Canarias, con algunas referencias a Ceuta y la Isla de Alborán. *Iberus,* suplemento 1:1–84.

COSTA, A. 1865. *Di una nuova specie mediterranea di molluschi pteropodi del genere* Spiralis. *Rendiconti dell'Accademia delle Scienze Fisiche e Matematiche di Napoli* (4):1–4.

COSTA, A. 1869. Illustrazione di due generi di molluschi nudibranchi. *Atti della Reale Accadmia delle Szienze Fisiche e Matematiche di Napoli* 3(19):1–6, Tav. I.

COSTA, O.G. 1829. *Catalogo sistematico e ragionato de' testacei dele Due Sicilie.* Tipografia della Minerva, Napoli, Italy. 8 + cxxxii pp., Tav. I–II.

COSTELLO, M., L.C. EMBLOW, AND R. WHITE, EDS. 2001. *European Register of Marine Species. A check-list of marine species in Europe and bibliography of guides to their identification.* (Patrimonies Naturels) 50. Museum National d'Histoire Naturelle. Paris, France. 463 pp.

CHÍA, M. DE. 1911–13. Aplec de notícies sobre els mol.luscs de Catalunya i catáleg provisional dels mateixos. *Bulletì de l'Istituciò Catalana d'Historia Natural,* 2ª época, 11:12–16, 28–33, 58–63, 66–72, 108–112, 127–128, 139–141; 12:11–13, 18–24, 103–107, 126–128, 157–159, 189–191; 13:109–111; 14:58–68.

CIMINO, G. 1989. *Salvatore Trinchese: Opera.* Edizioni Theoria, Roma, Italia. 326 pp.

FAHEY, S.J., AND T. GOSLINER. 2004. A phylogenetic analysis of the Aegiridae Fischer, 1883 (Mollusca, Nudibranchia, Phanerobranchia) with descriptions of eight new species and reassessment of phanerobranch relationships. *Proceedings of the California Academy of Sciences,* ser. 4, 55(34):613–689.

FAULKNER, D.J., AND M.T. GHISELIN. 1983. Chemical defense and the evolutionary ecology of dorid nudibranchs and some other opisthobranch gastropods. *Marine Ecology—Progress Series* 13:295–301.

FEZ, S. DE. 1974. *Ascoglosos y Nudibranquios de España y Portugal.* CSIC, Valencia, Spain. 325 pp.

GARCÍA, J., AND J. TRONCOSO. 1999. Description of a new species of *Phidiana* Gray, 1850 (Nudibranchia: Facelinidae) from Pacific Ocean waters of Panama. *The Veliger* 42(2):190–193.

GARCÍA, J., AND J. TRONCOSO. 2001. *Favorinus elenalexiae,* a new species (Opisthobranchia: Aeolidiidae) from the estern Pacific Ocean. *Nautilus* 115(2):55–61.

GARCÍA-GÓMEZ, J.C., J.L. CERVERA., F.J. GARCÍA, J., S.F. GARCÍA-MARTÍN, A. MEDINA, AND L.P. BURNAY. 1991. Resultados de la campaña internacional de biología marina "Algarve 88": moluscos opistobranquios. *Bollettino Malacologico* 27(5–9):125–138.

GASCO, F. 1878. *Paolo Panceri.* Cav. G. de Angelis e Figlio, Napoli, Italia. 36 pp.

GHISELIN, M.T. 1993. How well known is the opisthobranch gastropod fauna of Madang, Papua New Guinea? *Proceedings of the Seventh International Coral Reef Symposium, Guam, 1992,* 2:697–701.

GOSLINER, T., AND R. DRAHEIM. 1996. Indo-Pacific opisthobranch gastropod biogeography: how do we know what we don't know. *American Malacological Bulletin* 12(1/2):37–43.

GROEBEN, C. 1996. *Naturalisti a Napoli nella prima metà dell '800.* Pages 76–84 *in* F. Cacciapuoti, C. Groeben, and J. Massarese, eds., *Il sogno mediterraneo: tedeschi a Napoli al tempo di Goethe e di Leopardi.* Gaetano Macchiaroli Editore, Napoli, Italia.

GROEBEN, C. 2008. Tourists in science: 19th century research trips to the Mediterranean. *Proceedings of the California Academy of Sciences,* ser. 4, 59(9):139–154 [this volume].

GROEBEN, C., AND M.T. GHISELIN. 2001. The Zoological Station at Naples and its impact on Italian zoology. Pages 321–347 *in* A. Minelli and S. Casellato, eds., *Giovanni Canestrini, Zoologist and Darwinist.* Istituto Veneto di Scienze, Lettere ed Arti, Venecia, Italia.

HIDALGO, J.C. 1916. Datos para la fauna española (Moluscos y Braquiópodos). *Boletín de la Real Sociedad Española de Historia Natural* 16:235–246.

HIDALGO, J.C. 1917. Fauna malacológica de España, Portugal y las Baleares. *Trabajos del Museo Nacional de Ciencias Naturales,* Serie Zoología, 30. Madrid, Spain. 752 pp.

KANDEL, E. 1979. *Behavioral biology of* Aplysia *:a contribution to the comparative study of opisthobranch molluscs.* W. H. Freeman and Company, San Francisco, California, USA. xiii + 463 pp.

KROHN, A. 1847. Observations sur deux nouveaux genres de gastéropodes (*Lobiger* et *Lophocercus*). *Annales des Sciences Naturelles, Zoologie* (3)7:52–60, pl. 2.

LACAZE-DUTHIERS, H. 1859. Histoire anatomique et physiologique du pleurobranche orangé. *Annales des Sciences Naturelles, Zoologie* 11:201–202, pls. 6–12.

MALUQUER, J. 1904. Contribució a la fauna malacológica de Catalunya, III. Alguns molluscs marins del Masnou. *Boletín del Instituto Catalán de Historia Natural*, 2ª época, 1:69–74.

MALUQUER, J. 1907. Molluscs marins de Catalunya. *Boletín del Instituto catalán de Historia Natural*, 2ª época, 7:19–21.

MALUQUER, M. 1906–1909. Molluscs marins de Catalunya. *Trabajos del Museo de Ciencias Naturales de Barcelona* 1906–1907:14, 27, 42 and 103.

MALUQUER, M. 1912. Contribució a la fauna malacologica de Catalunya. *Boletín del Instituto Catalán de Historia Natural,* 2ª época, 12:50.

MALUQUER, M. 1915. Mollusc de la costa de l'Empordá. *Boletín del Instituto Catalán de Historia Natural*, 2ª época, 15:87–88.

MALUQUER, M. 1916. Treballs oceanografics de la costa de l'Epordá. *Annuari—Junta de Ciènces Naturals*, Barcelona: 221–261.

MCLELLAN, M.E. 1927. Dr. Rudolph Amandus Philippi. *The Auk* 44:158–159.

NOBRE, A. 1936. *Moluscos marinhos de Portugal*. Porto, Portugal 2:1–378.

NOBRE, A. 1938–1940. *Fauna malacológica de Portugal I. Moluscos marinhos e das águas salobras*. Companhia Editora do Minho, Porto, Portugal. 806 pp.

PANCERI, P. 1869. Gli organi e la secrezione dell'acido solforico nei gasteropodi, con un'appendice relativa ad altri glandolari dei medisimi. *Atti della Reale Accademia delle Scienze Fisiche e Matematiche di Napoli*, 4(10):1–56.

PHILIPPI, R.A. 1836. *Enumeratio molluscorum siciliae cum viventum in tellure tertaria fossilium quae in itinere suo observavit*. S. Schropp, Berlin, Germany. xiv + 267 pp.

PHILIPPI, R.A. 1839. Einige zoologische Notizen. 1. Zwei neue Arten von *Euplocamus*. *Archiv für Naturgeschichte* 5:111–134, Taf. I–IV.

PHILIPPI, R.A. 1841. Zoologische Bemerkungen. *Archiv für Naturgeschichte* 7:42–59.

POLA, M., J.L CERVERA, AND T.M. GOSLINER. 2007. Phylogenetic relationships of Nembrothinae (Mollusca: Doridacea: Polyceridae) inferred from morphology and mitochondrial DNA. *Molecular Phylogenetics and Evolution* 43:726–742.

PRUVOT, G. 1901. Le "Roland" et sa première croisiére sur la côte de Catalogne en juillet-aout 1900. *Archives de Zoologie Experimentale et Generale* 9:1–42.

RISSO, A. 1818. Sur quelques Gastéropodes nouveaux, Nudibranches et Tectibranches observées dans la mer de nice. *Journal de Physique* 87:368–377.

RISSO, A. 1826. *Histoire naturelle des principales productions de l'Europe Méridionale et particulièrement de celles des environs de Nice*. F.-G. Levrault, Paris, France. 5 vols.

ROS, J. 1975. Opistobranquios (Gastropoda: Euthyneura) del litoral ibérico. *Investigación Pesquera* 39(2):269–372.

ROS, J. 1976. Catálogo provisional de los opistobranquios (Gastropoda: Euthyneura) de las costas ibéricas. *Miscelánea Zoologica* 3(5):21–51.

ROS, J. 1976a. Sistemas de defensa en los Opistobranquios. *Oecologia aquatica* 2:41–77.

ROS, J. 1981. Desarrollo y estrategias binómicas en los opistobranquios. *Oecologia aquatica* 5:147–183.

ROS, J. 1984. Les nudibranches en tant que sémaphores: messages vrais et messages faux daris la communication visuelle d'un groupe de mollusques benthiques. Pages 325–335 in A. de Haro and X. Espadaler, eds., *Processus d'acquisition precoce. Les communication*. (*Publ. Universitat Autónoma de Barcelona et la Societè Française pour l'ètude du comportement animal*).

SAMA, A. DE. 1916. Mollusca marina in littora Calafell et Villanova s Antoni de Samà lecta. et nunc in Museo Barcinonense Scienciarum Naturalium servata. *Annuari — Junta de Ciènces Naturals,* Barcelona, 1916: 47–62.

SCHMEKEL, L., AND D. CAPPELLATO. 2001. Contributions to the Runcinidae. I. Six new species of the genus *Runcina* (Opisthobranchia Cephalaspidea) in the Mediterranean. *Vie et Milieu* 51(3):141–160.

SCHMEKEL, L., AND D. CAPPELLATO. 2002. Contributions to the Runcinidae. II. Three new species and comparative studies on five established species of *Runcina* (Opisthobranchia Cephalaspidea) in the Mediterranean. *Vie et Milieu* 52(2–3):85–102.

SCHMEKEL, L., AND A. PORTMANN. 1982. *Opisthobranchia des Mittelmeeres*. Springer Verlag, Berlin, Germany. 410 pp.

VALDÉS, Á. A phylogenetic analysis and systematic revision of the cryptobranch dorids (Mollusca, Nudibranchia, Anthobranchia). *Zoological Journal of the Linnean Society* 136:535–636.

VAYSSIÈRE, A. 1898. Monographie de la famille des pleurobranchidés. I. *Annales des Sciences Naturelles, Zoologie* 8(8):209–402.

VAYSSIÈRE, A. 1900. Considérations sur les différences qui existent entre la faune des Opisthobranches des côtes océaniques de la France et celles des nos côtes Méditerranéennes. *Comptes Rendus de l'Académie des Sciences de Paris* 130:926–927.

VAYSSIÈRE, A. 1901. Monographie de la familie des Pleurobranchidés (Deuxiéme et dernière partie). *Annles des Sciences Naturelles, Zoologie* 12:1–85, pls. 1–6.

VAYSSIÈRE, A. 1910. Nécrologie (Rudolph Bergh 1824–1909). *Journal de Conchyliologie* 58:1190–119.

VAYSSIÈRE, A. 1913. *Mollusques de la France et des regions voisines*. I. Encyclopedie Scientifique, G. Doin et Cie Edit. Paris, France. 420 pp.

VAYSSIÈRE, A. 1920. Sur la faune marine de la côte occidentale du golfe de Marseille. *Comptes Rendus de l'Académie des Sciences de Paris* 170:914–916.

VAYSSIÈRE, P. 1975. Albert Vayssière (1854–1942), entomologiste et malacologiste: sa vie, ses publications, ses taxa. *Tethys* 7:321–338.

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Tourists in Science: 19th Century Research Trips to the Mediterranean

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During the first half of the 19th century a considerable number of German scientists came to Italy to conduct research on the shores of the Mediterranean. These 'tourists in science' were part of the long tradition of artists, poets, scholars, and aristocrats attracted to Italy by the traces of the past, art, natural beauty, and the Mediterranean way of life. Scientists were drawn to places that allowed them to combine their research with sightseeing. Four cities in particular were favoured in this sense: Nice, Trieste, Naples, and Messina. Focussing on the latter two cities, this paper investigates several aspects of this new kind of adventure trip, namely the growth of local research traditions and international networks for the exchange of information and research material. Particular attention is given to the role of local hosts such as Stefano delle Chiaie, Arcangelo Scacchi, and Guglielmo Guiscardi in Naples and the German scientists August Krohn and Rudolph Amandus Philippi both in Naples and Messina. It is shown that not only did serendipity continue to prevail in such *ad hoc* organised field trips but that well organised research facilities, such as the Stazione Zoologica (1872) at Naples, turned out to be an answer to the need for better administration of individual resources.

Introduction

Kennst du das Land, wo die Zitronen blühn,
Im dunklen Laub die Gold-Orangen glühn,
Ein sanfter Wind vom blauen Himmel weht,
Die Myrte still und hoch der Lorbeer steht,
Kennst du es wohl? Dahin! Dahin
Möcht ich mit dir, o mein Geliebter, ziehn!

Do you know the lands where the lemons blossom?
Where the gold oranges glow in the dark leaves,
A gentle breeze blows from the blue sky,
The myrtle stands silent and the laurel tall?
Do you know it? There, there,
I long to go with you, my love.[1]

Mignon's lovely song from Goethe's novel *Wilhelm Meister's Apprenticeship* immediately comes to a German mind when thinking of Italy. Someone even stated that the love for Mediterranean solarity is embedded in the genetic code of all Germans. Certainly not, but the number and variety of Germans from all backgrounds and upbringing who have travelled to Italy across the

centuries is amazing. Some of them shaped their experience into works of culture or art through which their Italian experiences will continue to be remembered.

Johan Wolfgang von Goethe came in 1786–88; curious and full of expectancy, he is seen here looking out of the window in his Roman flat (Fig. 1). One can feel his longing to be down in the street, to become part of what he is only looking at. His experiences are forever fixed in his beautiful *Roman Elegies* (1788–1790) and the diary *Italian Journey* (1786–1788). The German composer Felix Mendelssohn-Bartholdy (1809–1847) came in 1831; in Naples and Rome he started to think about his Italian Symphony.[2] The German poet Wilhelm Müller (1794–1827) and the German painter and poet August Kopisch (1799–1853; Fig. 2) brought back collections of Italian folk songs. (Wolff 1829; Kopisch 1838) To Kopisch we owe a most entertaining translation of the Neapolitan fish song "Il Guarracino" (Groeben and Gambi 1992), but more important, Capri owes him the rediscovery of the Blue Grotto (Kopisch s.d.; Fig. 3). The excavations at Pompei and the eruptions of Mount Vesuvius also played a large role in attracting visitors and experts. Scientists travelled to the Mediterranean with the intent to collect material and do serious research. References to research stays at the seaside, mostly during the early period of a scientific career, may be found in many biographies, obituary notes and scientific publications.

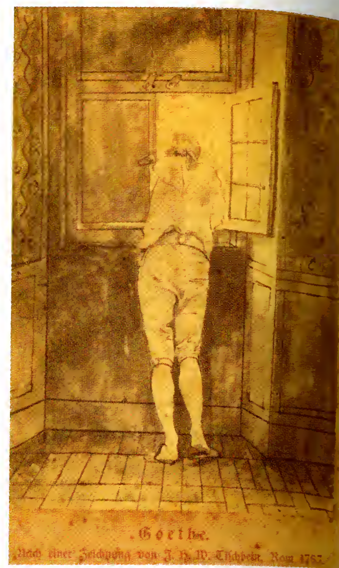

FIGURE 1. Goethe in Rome, drawing by J.H.W. Tischbein, 1787. Author's collection.

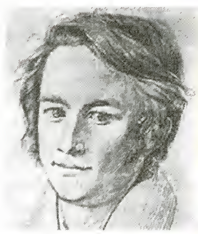

FIGURE 2. August Kopisch.

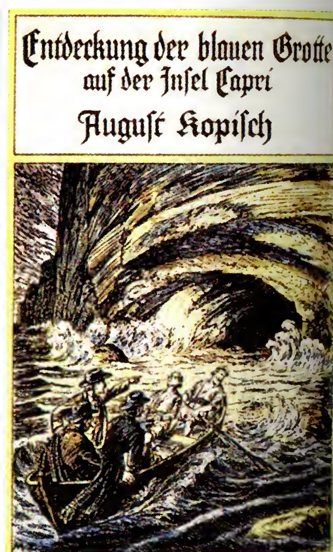

FIGURE 3. Discovery of the blue grotto on the island of Capri, by August Kopisch, [1925], cover page.

It is my intention in the discussion that follows to throw some light on this particular group of 'tourists in science', as I would like to call them, because tourists they were who also came for something that they wanted to take home. But they were different from those tourists who came for traces of the past, beauties of nature or works of art. They were less unobtrusive because the resulting scientific papers were much less obvious or fancy than a painting, a book, a symphony, or a poem. Some light will be thrown on this phenomenon as a whole, i.e., not so much on the significance of these trips for a single person, but rather as an attempt to answer questions such as "Where did they go?", "How did they work?", "With whom did they meet?", "What did they achieve?"

1. Getting Prepared

At one time, and with special reference to marine biology, when there was still much to discover and to describe, a scientist who wanted to further his knowledge could either study collections at museums or ask friends to collect organisms for him — or he could travel to the sea himself. The latter was often a trip into the unknown because of the lack of on-site information. For

instance, Karl Ernst von Baer (1792–1876) travelled during the summer of 1846 from St. Petersburg to Trieste to study the development of sea-urchins and ascidians. Years later he recalled:

> So little then one was used to this kind of investigation that I could find no information on the right time for such studies. Only when in Trieste did I discover that I had arrived much too early and that the spawning season would start three months later. In addition, the local fishermen were not experienced in getting sea-animals that cannot be eaten. I obtained only what they found by chance. (Raikov 1968:212–213.)

In this way von Baer did see many new organisms, but he could not make continuous studies because the animals did not live for more than two days because he had no aquaria in which to keep them properly. When he finally received sea urchin embryos, the chambermaid thought they were rubbish and threw them out the next morning.

Very often a scientist also had to improve reported methods and tools and adapt them to his own purposes. For example, Alexander Kowalewsky (1840–1901) found the much praised "Müller-net" for plankton fishing of no use for him because the mesh was too large for the ctenophore eggs in which he was interested (Kowalewsky 1866:16). He, therefore, kept fertilized animals in large buckets and nursed them to hatching by constantly changing their water.[3]

Other problems to be faced before departure, were the choice of sites and lodgings, and what kind of equipment to take along. Anton Dohrn, for instance, left for Helgoland in 1865 with several textbooks, nets, two microscopes, a Brücke magnifier, and "incredibly beautiful hats for all occasions".[4] Two years later (1867) Ernst Haeckel (1834–1919) and Nikolai Micloucho Maclay (1846–1888; Fig. 4) seem to have left for Lanzarote rather well prepared, but by then Haeckel could already look back to earlier field experience in Helgoland and southern Italy.

2. Who Came?

Attention is here focused on German scientists and those who studied in Germany and/or published in German. This limitation is not as arbitrary as it might seem because most of the scientists travelling to the Mediterranean *were* Germans, whereas French, British and Scandinavian scientists did their research at home, at their own national seaside resorts. For Germans, the main reason cannot only have been the relative inaccessibility or scarcity of marine fauna of the German seas, because, since the 1830s the island of Helgoland, then still British property, attracted a considerable number of scientists (Florey 1995), but it appears that many of them later also travelled to the Mediterranean, rather as if Helgoland had whetted their appetite for more. We may

FIGURE 4. Nicolai Micloucho-Maclay and Ernst Haeckel at Lanzarote, 1867. ASZN:La.13.

mention here Christian Gottfried Ehrenberg (1795–1876), Rudolph Amandus Philippi (1808–1904), Albert Koelliker (1817–1905), Carl Gegenbaur (1826–1903) and, of course, Ernst Haeckel.

Before there were railway connections, travelling to Italy was rather time consuming. Once or twice a week there was a boat from Naples to Messina that took two days travel time. And in 1854 Johannes Müller (1801–1858; Fig. 5) reported to a friend that it had taken him only nine days to return from Sicily to Berlin (Retzius 1900:73). The willingness to endure the stress of such long travels was certainly not exclusively motivated by striving for knowledge and a certain love of adventure; these scientists also wanted to share the experience that for centuries had already brought an endless flow of artists, poets, naturalists and travellers to Italy. However, 'tourists in science' distinguished themselves from tourists in nature and culture insofar as they tended to mix the enjoyable with the profitable, the thirst for culture with the drive for discovery.

FIGURE 5. Johannes Müller. *In*: Retzius, 1900, frontispiece.

3. Naples and Messina

Four cities seem to have been favoured by scientists in this sense: Nice on the French Riviera, Trieste on the Adriatic, and Naples and Messina in the South. The Riviera and the Adriatic could quite easily be reached from Northern Europe, whereas it took two to four additional days to reach southern Italy. In spite of their distance, Naples and Messina may be considered complementary because both were part of the Kingdom of Both Sicilies: Naples (Fig. 6) as the splendid Capital with a number of scientific institutions that promised contacts and exchange; Messina as the place

FIGURE 6. Naples and Mount Vesuvius at the end of the 18th century.

known for the richness of its fauna and flora ever since in 1788 Lazzaro Spallanzani (1729–1799) had observed and studied there various organisms of the pelagic and littoral fauna.[5] Interestingly, most of the scientists known to me at this time visited and worked at both Naples *and* Messina.

FIGURE 7. Naples, Santa Lucia in the 1880s. Author's collection.

During the period considered here, the city of Naples presented itself very differently to visitors arriving from the sea. The hills of Vomero and Posillipo were still not built upon, and the impressive regular rows of houses and hotels lining the waterfront were yet to come. The grandiose extraction of new building land from the sea completely transformed the shoreline from Mergellina to Santa Lucia during the last quarter of the 19th century. The street of Santa Lucia (Fig. 7), often described as the lively centre of the city, was a broad well-paved street, decorated with fountains, with a splendid view of the city, the port, the sea, and Mount Vesuvius. There were oyster and fish sellers, small restaurants, bathing establishments, and sellers of healthful sulphur water. At the upper end there was the Hotel de Rome where many foreigners stayed, among them, in 1842, Johannes Müller. Private rooms could be rented in the houses on the landside of the street. In 1842, Albert Koelliker, Carl Nägeli, and August Krohn lodged at no.21, as did the German historian Theodor Mommsen in 1845 and Ernst Haeckel in 1859. Via Santa Lucia seems to have been popular among those who appreciated simple lodgings. In 1831, we find there the composer Felix Mendelssohn, and in 1856 the entomologist Carl August Dohrn with his wife Adelheid and his oldest son Heinrich. The Russian embryologist Alexander Kowalewsky stayed at no. 92 several times (1864–66, 1868, 1870–71)[6], and zoologist Carl Claus (1835–1899) found quarters there in 1873, thanks to the efforts of Anton Dohrn.[7] Haeckel was particularly pleased with the view from his lodgings, which he described to his fiancée as follows:

> ... the full front across the Gulf is taken up by Vesuvius, the masses of lava of which present me the whole day long with the most splendid fireworks. On the right I look over the picturesque Castel dell'Ovo towards the jagged mountains of Sorrento and further on, beautiful Capri, to the left over the arsenal and the forest of masts of the port towards the snow-covered highest range of the Apennine. The purest sea-air blows all day long over the splendid, dark blue Gulf into my room. At my feet I have the multicoloured jumble of the beach-people, the vivid life of the S. Lucia fishermen. . . .Going down two small flights of stairs and across the street, in just 20 steps I am on the beach where I can easily help myself to fresh seawater and, in case the fishermen do not bring any decent material, also to a sufficient quantity of algae and smaller animals from the shore. (Haeckel 1921:27–28)

The port of Messina, in particular, was known to be a rich site for a great variety of research materials. Visiting scientists seem to have favoured the Hotel du Nord close to the port (Haberling 1924:387). They also joined the existing German colony. Feeling somehow at home was always an important factor in surroundings where one did not know the language and was unfamiliar with local habits. On the other hand, especially in Messina, there also existed a lively local tradition of natural history studies. At Catania, the Accademia Gioenia had been founded in 1824, and contributions to its proceedings regularly reported on findings in natural history. Academic partners,

often mentioned in letters and publications, were Carlo Gemmellaro (1787–1866),[8] Carmelo Maravigna (1758–1851)[9], and Anastasio Cocco (1799–1854).[10] And for more than 20 years (1818–1842), the local and visiting scientific community was enriched by the presence of Jeannette Power Villepreux (1794–1871) who has to be located somewhere in the midst between native members and long- or short-term visitors.[11]

Villepreux was born in 1794 at Juillac (Corrèze, France). In 1818, she married the English merchant James Powell at Messina where he had a successful business. Mrs. Power spent her free time exploring Sicily; in 1842, before concentrating her interest on marine animals, she even published a guide to the Island (Power 1842). She seems to have followed Louis Agassiz' much quoted motto "Study nature not books", convinced that first of all it needs the careful observation of developmental processes. What she did, and what makes her probably rank in a top position in the history of research aquaria (Gage 1883) was that in 1832 she started to build several types of aquaria, each based on the size of the animals she wanted to observe. Some of the aquaria she kept at her house in Messina. Others[12] (Fig. 8) were anchored in a quieter part of the port of Messina where she could observe the development and behaviour of *Octopus* and her favourite animal, *Argonauta* (Fig. 9). For instance, she observed something that had only been reported by Pliny the Elder, namely, an octopus holding a piece of rock, patiently waiting in front of a *Pinna nobilis*. As soon as the *Pinna* opened its shells, the octopus pushed the rock between them so that they could not be closed, which then allowed the octopus to feast on the mollusc at its leisure. To Jeannette Power we also owe the proof that the *Argonauta* produces its shell, that it is, therefore, not a squatter like Bernard the eremite, and that the mollusc can also repair damaged parts of its shell. Power was well read and had good connections. Her results and a collection of at least 20 well-preserved *Argonauta* were sent to Richard Owen who reported on her findings at the Zoological Society of London in 1839 (Owen 1839). The same year she was nominated corresponding member of the Society, a rare honour for a woman. Her results were also published in German (Power 1845). In his work on *Argonauta argo*, Rüppell refers to her work (Rüppell 1852:213–214). Naturalists travelling to Sicily, thus, knew about her presence, her work, and the working conditions at Messina.

More or less casual encounters could also lead to a mini-network of shared responsibili-

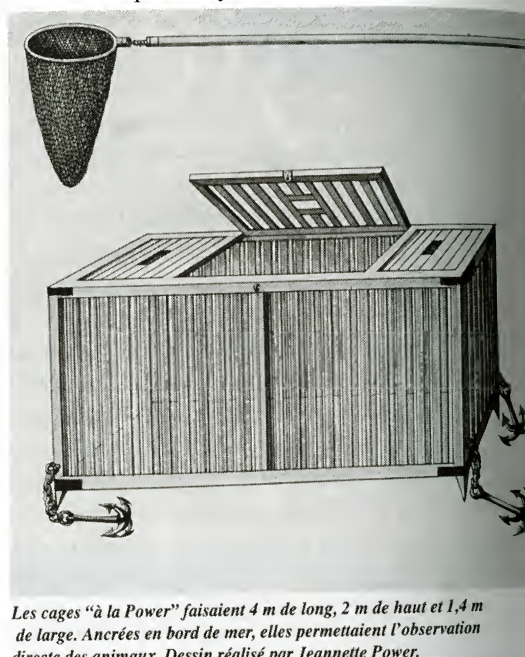

FIGURE 8. Power Cage for the observation of marine organisms. Drawing by Jeanette Power. 1839.

FIGURE 9. Argonauta, sketch by Jeannette Power. 1839. *In*: Guiffre 1994:53.

ties. In 1852, Albert Koelliker, Heinrich Müller, and Carl Gegenbaur met at Messina; they divided the work among themselves and published a joint report. Koelliker worked on Medusae and Siphonophores, Müller on Salps and Cephalopods, and Gegenbaur on Pteropods and Heteropods (Koelliker 1899:152).

4. Interacting with Research Sites

Ernst Haeckel and Albert Koelliker may serve here as examples for two different kinds of Naples experiences, probably conditioned by a combination of external and internal factors. Koelliker came in 1842 from Zurich together with his friend, the botanist Carl Nägeli (1817–1891). He was enthusiastic about Naples; his studies on the development of *Sepia* proceeded well, and he collected and preserved great quantities of material for himself as well as for Professor Jacob Henle and the anatomical Museum in Zurich. The 3½ months spent in Naples were interrupted by six equally satisfying weeks in Messina.

"I get the rarest animals, animals that I have never seen in Naples", he wrote home from Messina, "and four to twelve times cheaper than there because I am the only one to buy such stuff and can therefore usually fix the price myself." (Koelliker 1899:76)

He finished up with a great barrel full of fish and more than 100 jars containing rare animals, among them several hundred *Amphioxus* that lasted him for more than one year. He also enjoyed mixing with the colony of foreigners (his scientific contacts will be mentioned later).

In contrast, Haeckel, upon his arrival, felt insecure because he had no well-defined project, and it was depressing that after two previous stimulating research stays at Helgoland (1854) and Nice (1856) in the company and under the guidance of friends, he now had to rely only on himself. He ill-suffered the noise and dirt and the unreliability of the fishermen, who rarely brought him what he had asked for. Limited space, disorder, and the nuisance of taking care of himself certainly did not help to lift his spirits. He describes his living conditions as follows:

> Already in itself the room is so narrow that a somewhat portly person can only turn around with some difficulty; but imagine also all the small household equipment and the tools of a naturalist; the nets, buckets for the sea-animals, the paper for plant-pressing hung and spread out for drying, the plant press, the different animals prepared for drying etc., and you have an idea of how squashed and uncomfortable one is. (23.5.1859; Haeckel 1921:54)

As to contacts, he had his daily meals with other Germans, he joined the German singing club and even found a diligent student in marine biology in the person of the Italian Admiral Acton. And he also spent some very pleasant weeks at Ischia and Capri. (Fig. 10)

Figure 10. Ernst Haeckel, Study on Capri, 1859. *In*: Uschmann 1983, Fig. 11, after p. 80.

The frustration about his work changed only at Messina where Haeckel spent six months working intensely with an iron discipline and almost without any human contact. There he found the right object for his studies; he discovered and described 144 new species of Radiolaria, in part thanks to his new Amici immersion microscope, which allowed a 1000-times magnification instead of the usual 3–400 times (Haeckel 1921:136). It was certainly useful that Haeckel could do without help from the

local fishermen. With the Müller-net he scooped up plankton from the water surface that he then examined at home drop after drop.

In general, research material could be obtained in different ways: buying from fishermen, usually after long bargaining; or collecting organisms along the shore and in shallow waters, as Haeckel had done at times in Naples. Others, such as Wilhelm Keferstein and Ernst Ehlers from Göttingen (1859) or Alexander Kowalewsky (1864 and 1865), relied at Naples on the understanding, help and expertise of an older fisherman, Giovanni di Giovanni, who had acquired practice during years of satisfying the odd requests of those “foreigners”. At Messina, naturalists such as Johannes Müller, Hermann Troschel, as well as Haeckel met with similar competent assistance from Domenico Nina. (Haeckel 1921:160)

5. Motivations

There exists a wide range of motivations for a research stay along the shores of the Mediterranean. Some researchers came out of pure scientific interest. The professor of Anatomy from Tübingen, Wilhelm Rapp (1794–1868), arrived in Naples in 1825 because he wanted to learn more about the structure of polyps in general and actinia in particular. After having gathered still more data at Cette and Nice and in Norway, he published his results in 1829 (Rapp 1829).

Johannes Müller came to Naples in 1842 with the aim of further studying *Amphioxus*. This strange animal, discovered in 1834 and first correctly described by Oronzio Gabriele Costa as *Branchiostoma lubricum* (Costa 1834:49), immediately aroused the curiosity of experts because, phylogenetically, it was at the origin of vertebrates, although it has no vertebrae. *Amphioxus* soon became a sort of best-seller and drew many scientists to Naples, where, at that time, it could be caught easily in the shallow waters of Posillipo. Müller himself had already published a monograph on *Branchiostoma*, based on studies in Sweden.[13] Upon his request, Costa had also sent him several animals in 1840.[14] This time Müller took 1,000 preserved specimens back home.

Others went to the sea because they were fascinated by the richness of its fauna, which could easily be obtained and observed on site, preserved for future use, or on commission for colleagues, museums or institutes. Franz Hermann Troschel, Professor of Zoology at Bonn (1851) and for many years editor of the *Archiv für Naturgeschichte* (1849–1880), in 1853 at Messina, collected and preserved so diligently and so much that Johannes Müller, who was with him there and happy to be able to work again on Echinoderms (Retzius 1900:71), decided to spare himself the trouble and to buy from Troschel what he needed for the Berlin Museum. Seven years later Haeckel, on his departure from Messina, needed 12 long days — and a good nose — before the 12 crates of collected specimens were ready for departure, five for himself, two for the Anatomical Museum at Bonn, and one for the Zoological Museums at Jena and Berlin; the last three were less offending to his nose because they contained wine, minerals, and art objects.

Still other scientists came for health reasons. In these cases, studies in marine biology were a serious, but not too stressing activity during the long months or years full of hope for improvement. This was true of Edouard Claparède (1832–1871), for instance, who, however, did *not* get better in Italy. On his way back from Naples, he died at Siena in 1871 at the young age of 39. On the other hand, for August Krohn and Rudolph Philippi the stay in the South seems to have brought about a definite turn for the better; they died at age 87 and 95, respectively.

6. Local Scientific Contacts

During the first half of the 19th century, no other city in Italy was as rich in scientific institutions as Naples; among them were the University (1224), the Academy of Sciences (De Sanctis 1986:63), the Mineralogical Museum (1801), the "Royal Institute for the encouragement of natural sciences" (Reale Istituto d'incoraggiamento delle scienze naturali, 1806 [De Sanctis 1986]), the Botanical Garden (1809), the Observatory of Vesuvius (1845), and the Geological Museum (1865). The troubled political situation, however, impeded the formation of a continuous tradition. After the Revolution of 1799, many of the individuals associated with the institutions had to leave the country, among them Giosuè Sangiovanni (1775–1849), who went to Paris and studied with Lamarck, Cuvier, and Geoffroy Saint-Hilaire and who, after his return in 1808, introduced Lamarck's ideas to Naples. Following the liberal "French decade" (1805–1815), under the reign of Joseph Bonaparte and Gioacchino Murat, the restoration, with its suspicions of novelty and progress, and with its surveillance and controls, put constraints on what people could do, especially in the sciences. It is remarkable, however, that in 1845 the 7th congress of Italian scientists could be held in Naples, in the Museum of Mineralogy (*Atti* 1846; Fig. 11). No fewer than 1613 participants came including, among the 814 foreigners, personalities such as Lorenz Oken, Richard Owen, and Goethe's grandson (Azzinari 1995).

For the visiting zoologists and botanists, local colleagues were not always the most helpful contacts; rather versatile and extrovert personalities such as Stefano delle Chiaie or Arcangelo Scacchi seem to have been the exception. Albert Koelliker had brought letters of introduction from Lorenz Oken for Costa and Delle Chiaie. Haeckel turned to his colleagues Costa and the zoologist-geologist Guglielmo Guiscardi for advice and recommendations. There is less evidence for contacts with Oronzio Gabriele Costa (1787–1867; Fig. 12), Professor of Zoology at Naples (1839–49), who would have been the obvious person to turn to for help and advice. But, since 1837 Costa was extremely busy in publishing, under great efforts and sacrifices, his monumental work on the *Fauna of the Kingdom of Naples* (Costa 1831–1881). In 1849, Costa was discharged from his academic position and had to continue his research on a private basis. However, he also managed to continue his international contacts and to be a gentle and generous host, as has been reported by Koelliker[15] and Krohn.[16]

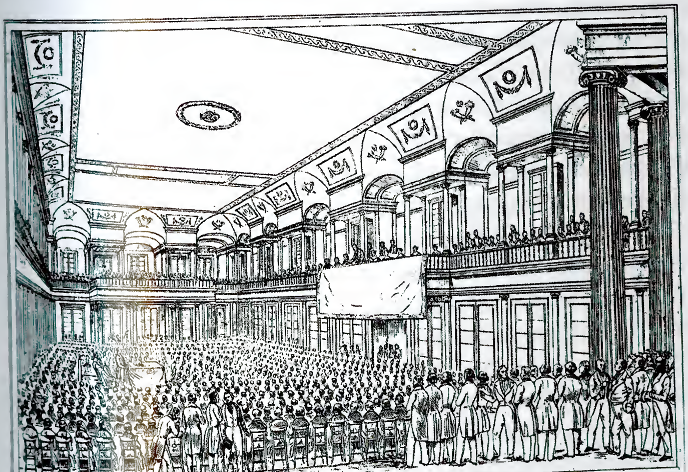

Figure 11. VII Congresso degli Scienziati a Napoli, inc. Fergola. 1845. *In*: Azzinari 1996:18.

Figure 12. Oronzio Gabriele Costa.

Stefano delle Chiaie (1794–1860; Fig. 13) had studied medicine but preferred a university career to that of a physician (Di Trocchio 1990). He became well known far outside the borders of the Naples Kingdom for his comprehensive and well-illustrated studies on the invertebrates of the Kingdom of Naples (4 volumes, 1823–29; 7 volumes, 1841–44; Delle Chiaie 1822–25; 1841–1844) At times he switched to botany and human medicine and also published the works of his teacher Giuseppe Saverio Poli (1746–1825) and of the outstanding zoologist Filippo Cavolini (1756–1810). A biographer summarises: "He was able to gain more laurels than were due to him." (Di Trocchio 1990:28) But what should be stressed here is the fact that Delle Chiaie always met colleagues from abroad with great amiability and stood at their disposal with advice and information. Koelliker visited him in 1842; with Krohn (1840) and Philippi, he maintained a friendly professional relationship; and with Ehrenberg he continued his epistolary contact long before the latter came to Naples in 1858.[17]

FIGURE 13. Stefano delle Chiaie. Museo Nazionale di San Martino, Naples, Fondo Poerio.

Arcangelo Scacchi (1810–1893; Fig. 14), the other friendly contact in Naples, started with a deep interest in marine biology; in 1836 he published a catalogue of the molluscan fauna of the Kingdom of Naples (Scacchi 1836). Around 1840 he turned to geology; four years later he became Professor of Mineralogy and Geology at Naples, and his collections of stones and minerals from Vesuvius brought considerable eminence to the Mineralogical Museum. With Philippi he undertook numerous collecting trips in 1839–40 — they shared an interest in molluscs — and, very generously, he donated artefacts and notes to his friend.

FIGURE 14. Arcangelo Scacchi, 1890. In: [Scacchi] 1910, frontispiece.

It may not be easy today to understand how difficult it was in the beginnings of modern marine biology to obtain good and sufficient research material. Scacchi frequently complained about the delays in sending and receiving collections of minerals to and from Berlin. Peter Simon Pallas (1741–1811) discovered the Branchiostoma in 1778 and based his description on a single preserved specimen he had received from Cornwall.[18] Anton Dohrn asked Darwin for help to get from the London Zoological garden a female *Limulus*, because he wanted to study its development. Darwin regretted that in London they had only one old male (Groeben 1982:25, 29). And Darwin himself, while working on Cirripedia, politely asked Johannes Müller whether he could have some specimens collected by Philippi in Sicily and deposited at the Berlin Museum. (Burkhardt and Smith 1988:213–214)

Slowly, but constantly a wealth of information became available through collections deposited in museums, through the exchange of specimens, and, of course, through publications; the countless articles and letters to the editors of specialised journals speak for themselves. This was the time of articles with stereotyped titles such as "On a new form of...", "On the development of ...", "On the (eyes, head, fins, habits) of...". The articles were published in new specialised jour-

nals: *Meckel's Archiv für Anatomie und Physiologie*, better known as *Müllers Archiv* (1815), the *Magazine of Natural History* (1828), the *Archiv für Naturgeschichte* (1835), and the *Zeitschrift für wissenschaftliche Zoologie* (1848) — to name only a few of the more important ones.

There are two names that appear regularly and frequently in these journals as authors and references. But, since one of them was never and the other one only barely linked to German institutional contexts, they are almost non-existent in the biographical literature. Here I refer to August David Krohn (1803–1891) and Rudolph Amandus Philippi (1808–1904), both of whom have already been mentioned.

August David Krohn was born at St. Petersburg[19] in 1803.[20] His father Abraham Krohn, the founder of Russia's first brewery, had left the island of Rügen in the Baltic Sea to serve at the court of Catherine the Great where he probably also studied medicine. About 1835, he left his position as professor of medicine at St. Petersburg for Hamburg from where he moved to Bonn University working on zoology, anatomy and embryology. In 1832, we find him for the first time in Naples.[21] Scientific publications by him on crabs, snails, birds, and amphibians are documented since 1834. After 1839, his interests seems to have turned exclusively to marine biology. Up to 1869, his articles appeared quite regularly in German periodicals, more than 80 titles mostly on the anatomy, development, and reproduction of invertebrates. From 1840 on he spent, probably for health reasons, regular periods every year at Naples, Messina, Nice, Tenerife and Madeira, the rest of the year in Paris or Bonn. Krohn died in Bonn in 1891, at the age of 87.

At both Naples and Messina, Krohn established friendly and scientific contacts with Stefano Delle Chiaie — they discussed the nervous system of echinoderms — and also with Johannes Müller, Philippi, Koelliker, Anton Schneider, Carl Gegenbaur and Hermann Troschel. In November 1871, he also visited Anton Dohrn in Naples, who was then busily engaged with the preliminaries for establishing a zoological station.

The following episode may serve to illustrate Krohn's role as a host in order to make foreign guests feel comfortable and at home in Messina and Naples where he himself had spent so much time. In 1853, Hermann Troschel prepared for a two-months trip to Messina and Naples, together with Johannes Müller (Haberling 1922:388). Krohn, who had just returned from Messina, wrote a 4-page letter to Troschel that contained all sorts of advice, from suggestions on the pickling of salps, medusae, and jellyfish, to prices for barrels, glassware (to be had at the Brothers Greco, which was close to the Hotel du Nord), lodgings, meals, assistance in fishing, including local contacts such as Anastasio Cocco and Lawyer Benoit. He recommended the Lazzaretto area outside the port of Messina for the study of cephalopods, pteropods and heteropods and the pelagic fauna in general, while Naples was the right place for studying polyps, Holothuria, ascidians, annelids, and Mollusca.[22]

FIGURE 15. Rudolph Amandus Philippi.

Rudolph Amandus Philippi (Fig. 15) was born in 1808 in Charlottenburg. After studies in medicine and natural science in Berlin, he lived from September 1830 to April 1832 in Sicily with two friends, mainly to collect molluscs. Four years later he published his standard work "*Enumeratio molluscorum...*" (Philippi 1836). In August 1835, we find him also in Helgoland, where from September on he taught at the professional High-school at Cassel and where he also served as director of the local Society for natural science. Between 1837 and 1839 he returned-

for 2½ years to Naples and Sicily, for health reasons. In August 1839 he was nominated corresponding member of the Naples Academy of Sciences — the only one from the group of the German marine biologists considered here. In 1851, Philippi resigned his position at Cassel for political reasons; he emigrated to Chile where he started a second scientific career. In 1904, he died at Santiago at the age of 95.

It is important to stress here that Krohn and Philippi, who met and interacted in Messina and Naples, both played important roles as hosts for their countrymen in southern Italy. Both lived for many years mainly in Italy where they gained experience and established contacts that they could pass on, and both constantly published their results, thus documenting the variety and abundance of research material in the Mediterranean Sea.

7. Conclusions

The period up to 1870 saw a growing interest in the exploration of marine life. Motivations for seaside studies were various, so was the search for solutions to practical problems. However, during this time, slowly, but constantly, a network of personal and scientific information was accumulated among long and short-term visitors to Italy and also among foreign visitors and local experts and institutions.

Around 1870, study periods of marine life began to turn from individual and, we might add, adventurous explorations into organised research stays. Individual makeshift labs began to be replaced by institutions such as the Stazione Zoologica where technical facilities for developmental, physiological and experimental studies were available.

When in October 1871 the 30-year old *Privatdozent* from Jena, Anton Dohrn (Fig. 16), transferred to Naples and set up at the Palazzo Torlonia (Fig. 17) a small lab with seawater aquaria, he was, in a certain sense, the last of a long line of naturalists who had come to the coasts of the Mediterranean for seaside studies. He could build on the experiences gained by the generation of naturalists that had preceded him. He could also draw from personal experiences, in 1865 at Helgoland with Haeckel, in 1867 and 1868 in Scotland with David Robertson, and during the winter of 1868–69 also in Messina with Nicolai Maclay. When in 1872 Dohrn decided to build the Zoological Station in Naples (Fig. 18) and not in Messina, as originally planned, he was in a way returning to where many of his teachers and colleagues had started their Italian scientific adventure.

The way of doing research in marine biology may have changed, but the attraction of the Mediterranean seems not to have

Figure 16. Anton Dohrn about 1871. ASZN.

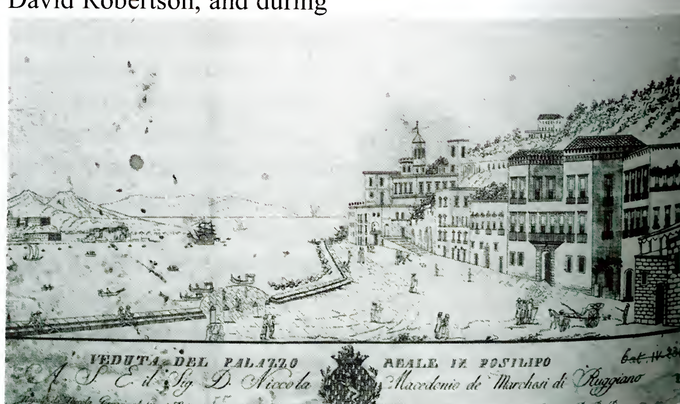

Figure 17. Building on the right with two towers: Palazzo Torlonia where Anton Dohrn lived from 1871 until 1875. *In*: Groeben 2000: 36.

changed at all. To make a research stay away from one's home lab profitable and also memorable, it always needed and still needs a counterbalancing factor to good working conditions. In the Mediterranean region, this continues to be European history and culture and the beauties of nature right at the front door. And by the end of the Nineteenth Century "tourists in Science" could enjoy their personal mix of work and play at the Stazione Zoologica, this great "Hotel for scientists" as the Italian historian and Philosopher Benedetto Croce labelled it in 1920 (Croce 1920:3).

FIGURE 18. The Zoological Station in 1873. Author's collection.

ABBREVIATIONS

ASZN Historical Archives of the Stazione Zoologica Anton Dohrn
BBAW Berlin-Brandenburgische Akademie der Wissenschaften

REFERENCES

ARNAL, C. 2003. *Jeannette Villepreux Power de Messine:* l'Argonauta argo *et l'invention de l'aquarium (1832).*cl_arnal@club-internet.fr

Atti della settima adunanza degli scienziati italiani tenuta in Napoli dal 20 di settembre a' 5 di ottobre del 1845, 1846. nella Stamperia del Fibreno, Napoli, Italy. Parte I: pp. 1–1110; Parte II: pp. 1111–1199; 3 pls., pp. 1*–96*; pp. i–cxciii.

AZZINARI, M., ED. 1995. *Il Settimo Congresso degli Scienziati a Napoli nel 1845. Solenne festa delle scienze severe*). Archivio di Stato, Napoli,.Italy. 208 pp.

BRUNI, V. 2008 (in press). *Researches on marine biology in the Straits of Messina: past and present.* Messina.

BURKHARDT, F., AND S. SMITH, EDS. 1988. *The Correspondence of Charles Darwin*, vol. 4. Cambridge University Press, Cambridge, UK. xxxvi + 711 pp.

CLAUS, C. 1875. *Schriften zoologischen Inhalts. I. Die Familie der Halocypriden. II. Die Gattung Monophyes Cls. und ihr Abkömmling Diplophysa Gbr.* Verlag der G.J. Manz'schen Buchhandlung, Wien, Austria.

COCCO, A. 1844. 'Intorno ad alcuni nuovi pesci del mare di Messina. Lettera del prof. Anastasio Cocco al Signor Augusto Krohn da Livonia', *Giornale del Gabinetto Letterario di Messina* 3(5):21-30.

COSTA, O.G. 1829–1860. *Fauna del Regno di Napoli, ossia enumerazione di tutti gli animali che abitano le diverse regioni di questo regno e le acque che le bagnano contenente la descrizione de' nuovi e poco esattamente conosciuti con figure ricavate da originali viventi e dipinte al naturale.* Azzolino, Napoli, Italy. Series of monographs

COSTA, O.G. 1834. *Cenni zoologici ossia descrizione sommaria delle specie nuove di animali discoperti in diverse contrade del Regno nell'anno 1834.* Tipografia di Azzolino e Comp, Napoli, Italy. 90 pp.

CROCE, B. 1920. *Sulla Stazione zoologica di Napoli. Discorso pronunziato al Senato il 9 dicembre 1920 dal Ministro della Pubblica Istruzione On. Croce.* Roma, Tipografia del Senato. 18 pp.

DE CEGLIE, R. 1999. *"L'anello mancante". L'opera di O.G.Costa nella biologia italiana del primo Ottocento.* Giuseppe Laterza sas, Bari, Italy. 143 pp.

De Ceglie, R. 2003. *Il carteggio Scacchi e le scienze della terra in Italia.* Lecce, Edizioni Pensa Multimedia.

Delle Chiaie, S. 1823–1829. *Memorie sulla Storia e Notomia delgi Animali senza Vertebre del Regno di Napoli.* Stamperia dei fratelli Fernandes, Napoli, Italy. 4 vols.

Delle Chiaie, S. 1841–1844. *Descrizione e notomia degli animali invertebrati della Sicilia citeriore (Regno di Napoli) osservati vivi negli anni 1822–1830.* Stabilimento tipografico di C. Batelli e Comp, Napoli, Italy. 7 vols.

De Sanctis, R. 1986. *La nuova scienza a Napoli tra '700 e '800, con una prefazione di Lucio Villari.* Roma-Bari, Gius. Laterza & Figli. xiii + 304 pp.

Di Trocchio, F. 1990. 'Delle Chiaie, Stefano'. In: *Dizionario biografico degli Italiani* 38:25–29.

Dohrn, A., ed. 1897. *Das 25jährige Jubiläum der Zoologischen Station zu Neapel am 14. April 1897.* Leipzig, Breitkopf & Härtel. 45 pp.

Dougherty, W. P. 2002. 'Mignon in Nineteenth-Century Song: Text, Context and Intertext'. Pages 123–141 *in* S.M. Lodato, S. Aspden, and W. Bernhart, eds., *Wordand Music Studies. Essays in Honour of Steven Paul Scher on Cultural Identity and the Musical Stage.* Rodopi. Rodopi, Amsterdam, Netherlands and New York, New York, USA. 324 pp.

Florey, E. 1995. 'Highlights and sidelights of Early Biology on Helgoland'. *Helgoländer Meeresuntersuchungen* 49:77–101, illus.

Gage, M.J. 1883. 'Woman as an Inventor'. *The North American review* 136:318 (May):478–490.

Groeben, C., ed. 1982. *Charles Darwin, 1809–1882, Anton Dohrn, 1840–1909: Correspondence.* Macchiaroli, Napoli, Italy.

Groeben, C. 2000. *The Fresco Room of the Stazione Zoologica Anton Dohrn. The Biography of a Work of Art.* Gaetano Macchiaroli Editore, Bapoli, Italy. 78 pp.

Groeben, C., and C.M. Gambi, eds. 1992. *lo Guarracino che jeva pe mare*). Gaetano Macchiaroli Editore, Naoli, Italy. 93 pp.

Guiffre, P. 1994. 'Jeannette Power et le mystère de l'argonaute'. *Océans* (mai-juin):52–55.

Haberling, W. 1922. 'Urkundliches über Johannes Müller und seine Vorfahren.' *Zeitschrift für Heimatkunde der Regierungsbezirke Coblenz und Trier* 3:220–220.

Haberling, W. 1924. *Johannes Müller. Das Leben eines rheinischen Naturforschers. Auf Grund neuer Quellen und seiner Briefe dargestellt von Wilhelm Haberling.* Akademische Verlagsgesellschaft, Leipzig, Germany. 501 pp., 9 pls., 1 facsimile.

Haeckel, E. 1921. *Italienfahrt. Briefe an die Braut. 1858–60.* K.F. Koehler, Leipzig,, Germany. 184 pp.

Jahn, I., ed. 2000. *Geschichte der Biologie. Theorien, Methoden, Institutionen, Kurzbiographien*), Spektrum Akademischer Verlag, Heidelberg / Berlin, Germany. 1088 pp.

Koelliker, A. v. 1899. *Erinnerungen aus meinem Leben.* Verlag von Wilhelm Engelmann, Leipzig, Italy. 399 pp.

Kopisch, A. 1838. *Agrumi: Volksthümliche Poesien aus allen Mundarten Italiens und seiner Inseln, gesammelt und übersetzt von August Kopisch.* Gustav Crantz, Berlin, Germany. vi + 390 pp.

Kopisch, A. [1925]. *Die Entdeckung der Blauen Grotte und Der Träumer.* Stiftungsverlag, Potsdam, Germany. 115 pp.

Kowalewsky, A. 1866. 'Entwickelungsgeschichte der Rippenquallen', *Mémoires de l'Académie impériale des Sciences de St. Pétersbourg, VIIe série,* 10(4):1–25, 25 plates.

[Krohn], 1891. 'Nekrolog.' *Zoologischer Anzeiger* 14:108.

Mendelssohn-Bartholdy, F. s.a. *Reisebriefe.* Drei-Brücken-Verlag, Mainz, Germany. 410 pp.

Müller, J. 1844. *Über den Bau und die Lebenserscheinungen des* Branchiostoma lubricum *Costa,* Amphioxus lanceolatus *Yarrel.* Druckerei der Kgl. Akademie der Wissenschaften, Berlin, Germany. 40 pp., 5 pls.

Owen, R. 1839. '[on the Paper *Nautilus Argonauta* Argo]'. *Proceedings of the Zoological Society of London* 7:35–48.

Pallas, P.S. 1769–1778. *Naturgeschichte merkwürdiger Thiere, in welcher vornehmlich neue und unbekannte Thierarten durch Kupferstiche, Beschreibungen und Erklärungen erläutert werden.* verlegts Gottlieb August Lange, Berlin und Stralsund, Germany. 56 pp.

Philippi, R.A. 1836. *Enumeratio Molluscorum Siciliae cum viventium tum in tellure tertiaria fossilium quae*

in itinere suo observavit. Simon Schropp, Berlin, Germany. 267 pp., 12 pls.

POWER, J. 1842. *Guida per la Sicilia.* Stabilimento poligrafico di F. Cirelli, Napoli, Italy. xxvi + 380 pp.

POWER, J. 1845. 'Bemerkungen über das Thier von *Argonauta* Argo'. *Archiv für Naturgeschichte* 11(1):369–383.

RAIKOV, B.E. 1968. *Karl Ernst von Bear 1792–1876. Sein Leben und sein Werk.* Johann Ambrosius Barth, Leipzig, Germany. 516 pp.

RAPP, W. 1829. *Ueber die Polypen im Allgemeinen und die Actinien insbesondere. Naturhistorischer Versuch.* Verlag des Grossherzoglichen Sächs. privileg. Landes-Comptoirs, Weimar, Germany. 60 pp., 3 pls.

RETZIUS, G., ED. 1900. *Briefe von Johannes Müller an Anders Retzius von dem Jahre 1830 bis 1857.* Aftonbladets Aktiebolags Tryckeri, Stockholm, Sweden. 84 pp., 1 port., 2 facsimilies.

RÜPPELL, W.P.E. 1852. 'Beiträge zur Naturgeschichte des Papiernautilus (*Argonauta* Argo Linn.) und insbesondere Beschreibung des bisher unbekannten vollständigen Männchens dieses Thieres'. *Archiv für Naturgeschichte* 18(1):209–219.

SCACCHI, A. 1836. *Catalogus Conchyliorum Regni Neapolitani quae usque adhuc reperit A. Scacchi.* Typis Filiatre-Sebetii, Neapoli, Italy. 18 pp., 1 pls.

[SCACCHI] 1910. 'Onoranze alla memoria di Arcangelo Scacchi nel I centenario della sua nascita.' *Rendiconto dell'Accadmia delle Scienze Fisiche e Matematiche (Sezione della Società Reale di Napoli)*, ser. 3a, 16(7–9, suppl.):1–43.

SICHEL, G. 1987. 'Carlo Gemmellaro e il suo tempo', *Atti della Accademia Gioenia di Catania* 162:63–73.

USCHMANN, G., ED. 1983. *Ernst Haeckel. Biographie in Briefen.*), Urania-Verlag, Leipzig / Jena / Berlin, Germany. 328 pp.

WOLFF, O.L.B. 1829. *Egeria. Raccolta di poesie italiane, cominciata da Guglielmo Müller, dopa la di lui morte terminata e pubblicata da O.L.B. Wolff.* Ernst Fleischer, Leipzig, Germany. xii + 262 + 8 pp.

NOTES

1 Translation by Eric Blackall (Dougherty 2002, 130).

2 Mendelssohn-Bartholdy, s.a.; letters from Naples: pp. 137–164, on the Symphony, p. 148.

3 Johannes Müller, instead, was so much satisfied with his invention that at a certain point he felt the need to invent something else because the net brought up more organisms already known to him than unknown (Retzius 1900:76).

4 Dohrn to Haeckel, 5 August 1865, Stettin. ASZN:Bc.110.

5 Senator Francesco Todaro in (Dohrn 1897:7)

6 Kowalewsky returned to Naples in 1887 and 1889 to work as guest investigator at the Stazione Zoologica. He also brought his family and could by then afford more luxurious quarters in Villa Amato at Posillipo.

7 Prof. C. Claus from Göttingen „will stay 6 weeks to work. I got him lodgings at Santa Lucia", Anton Dohrn told his fiancée Marie de Baranowska, letter, March 1873, Naples. ASZN:Bd.061. Claus 1875; on his stay in Naples: p. 1.

8 Carlo Gemmellaro, naturalist and vulcanologist, director of the Accademia Gioenia and professor of natural history at the University of Catania. (Sichel 1987)

9 Carmelo Maravigna, naturalist and mineralogist, professor of chemistry at the University of Catania, working on the vulcanology of Mount Etna. (De Ceglie 2003:43)

10 Physician and professor of pharmacology at Messina, described several new species. (Bruni, s.d.)

11 Acknowledgments have to be given to Claude Arnal who has collected an amazing amount of details and information regarding the biography of Jeannette Power. (Arnal 2003; Guiffre 1994)

12 Defined as "Gabbiole alla Power". There are different measures indicated, although some old measures may not have been translated correctly. In Power 1845:372, cages of 180 × 90 cm (8 × 4 "Spannen", 1 Spanne = 23 cm) are reported. Owen (1839:103) mentions 8 × 4 palms (61 × 30,5 cm, 1 palm = 7,65 cm), but if "palm = span, then it would be 180 × 90 cm as in the German translation. Fig. 8 shows one identified as 4 × 2 × 1,4m (Guiffre 1994:55).

13 Müller 1844; based on a report given to the Academy of Sciences at Berlin on December 6, 1841.

14 Reported in De Ceglie 1999:98. Müller based his results on research done of 12 animals at Bohuslän (Sweden) together with Anders Retzius. Specimens received from Costa are not mentioned in the monograph.

15 Koelliker 1899, 12; on Naples and Sicily: 11, 12, 65–83, 152–159. However, Koelliker also mentions that Oronzio Costa and his son and successor Achille (1823–1898; Prof. 1860–98) "kept their distance from their older colleagues, who worked in the same direction, with a tenacity frequently found with Italian scientists" (p. 12).

16 "Von den Naturforschern in Neapel ist Costa allein noch thätig und gegen die Fremden sehr dienstfertig" [Of the naturalists at Naples only Costa is still active and very helpful towards foreigners.] Krohn to Troschel, Letter and notes, Messina, 1 April 1854. BBAW, NL Troschel 220, ff. 10–15:15.

17 Five letters from Delle Chiaie to Ehrenberg (1836–1855) and two from Ehrenberg to Delle Chiaie (s.a.; 1840) are kept at the BBAW, Nachlass Ehrenberg 312, 659.

18 Having never seen a live animal, he took it for a slug and described it as *Limax lanceolaris* (Pallas 1769–1778, X:24–25).

19 Someone else locates him in Livonia (Cocco 1844).

20 Jahn 2000, 879. Krohn died on February 26, 1891 at the age of 87 (Krohn 1891). Not knowing the day of his birth, other sources give 1804 as the year.

21 In the records of foreigners arriving at Naples he is listed as "Gustavo [*sic*!] Davide Krohn" from Sweden, Physician, lodging at the 'Locanda di Russia', arrival date: March 13, 1832. Archivio di Stato, Napoli, Ministero di Polizia, Movimento Stranieri, Fs 2846 (Esteri di passaggio), no. 354.

22 August Krohn to Hermann Troschel, notes. 4 pp., n.d. [but 1853]. Berlin, BBAW, Literaturarchiv, Nachlass Troschel 220, n. 6.

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British Use and Support of the Naples Zoological Station Prior to the First World War

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Prior to World War I the Zoological Station at Naples was a German institution on Italian soil. However it was used by scientists of many nationalities and their governments and institutions helped to support it. They nonetheless engaged in rather different activities while there. There has been little effort thus far to characterize the British (mostly English, but some Scotts and Irish) as a group. Germans occupied the largest number of Tables (31%). Italy came next, with 25%, followed by Russia with 9% and then Great Britain with 7%.

The British scientists were supported by Tables from the British Association for the Advancement of Science and the universities of Cambridge and Oxford. Anton Dohrn, who founded the Station, had a strong supporter in Edwin Ray Lankester, who shared his evolutionary interests. Lankester encouraged his students to work at the Station and his student Edwin S. Goodrich did likewise. The result was an important tradition influenced by Dohrn's principle of the succession of functions.

German and Italian scientists were much interested in exploring the local fauna, and contributed to the Station's monograph series. Only one Englishman, Geoffrey Watkins Smith, produced a volume in the series. British scientists were interested in producing taxonomic monographs, but they were more interested in exploring their local faunas and undertaking more global investigations. Therefore they studied the Mediterranean fauna because it contained organisms that were not so easy to obtain or study elsewhere.

Founded by Anton Dohrn in 1872, the Naples Zoological Station has been the focus for quite a variety of historical studies. There are biographies and biographical essays of interesting persons, including of course Dohrn himself (Heuss 1991 and earlier editions; Kühn 1950). There have been studies dealing with the economics (in a broader as well as a narrower sense) of the Station (Partsch 1980; De Masi 1998; Ghiselin and Groeben 2000). Its famous frescoes by Hans von Marées have been the subject of much study and commentary (Groeben 1995; Santini and Groeben 2005). Other publications have focused on the development of various scientific disciplines at the Station (Ghiretti 1985; Monroy and Groeben 1985; Müller 1996).

Several publications have focused upon the various nations that have contributed to the life of the station. Some interesting patterns are suggested by these and the present essay is intended to add a bit to that line of research. We may begin by mentioning some of the publications that have such a focus. There are papers on female Americans (Zottoli and Seyfarth 1994; Sloan 1978), on Americans in general (Maienschein 1985), on the Dutch (Linskens 1975), on the Japanese (Mizoguchi 1998) and on the Russians (Orlov 2001; Ghiselin 2002). An entire book has been devoted to the Japanese (Nakano, Mizoguchi, and Yokota 1999), and one on the Russians (Fokin 2006) will soon appear in an English version. The Italians were largely neglected until quite

recently (Groeben and Ghiselin 2001). Lack of work on the French is easily explained (Fischer 1980). The French developed their own system of laboratories. As to the British, including the Scotch, Irish and Welsh, as well as other denizens of the Empire, there have been publications on some important personages, but nothing on them as a group. The present essay is not an effort to survey the British scientists who worked at the Station. Rather it is an effort to characterize the British presence there and to compare it with that of various other nationalities. As with most of my earlier work on the Station, the focus is on the period up to World War I, when there was a major hiatus.

The privilege of working at the Station was largely contingent upon grants from governments, universities and learned societies that funded so-called "Tables"— places in the laboratory together with the amenities that accompanied them. According to Groeben and Ghiselin (2001) 30% of Table holders from 1873 to 1915 were from Germany, 25% from Italy, 9% from Russia, 7% from Great Britain, 6% from Austria, 6% from the United States, 4% each from Switzerland, 4% from the Netherlands, 3% from Belgium, 2% from Spain, 1% from Hungary, 1% from Romania, and there were an additional, miscellaneous, 2%.

We should note at the outset that the English were highly supportive of the Station. Darwin in particular was very enthusiastic and supportive of Dohrn's efforts. Dohrn had visited him at Down House on September 26, 1870. They shared an interest in the evolution of crustaceans (Groeben 1982). Darwin sent copies of his publications. He contributed £120 in 1874, and in 1879, after receiving the Bressa Prize of the Royal Academy of Sciences of Torino, donated another £100. Dohrn proposed that the money be used to assist English scientists in working at the Station. Darwin also used his influence on other English scientists. The British Association for the Advancement of Science funded a Table at the Station and so did Cambridge and Oxford. That gave three Tables, so that for a time the number of British and American investigators at the Station was about equal. George Parker Bidder, an expert on sponges, was a classical English eccentric who is said to have worked at night and slept during the day (Sidney Smith, pers. comm.). He took care of his housing requirements in Naples by buying a hotel (renamed Parker's Hotel) there. He made special arrangements with Dohrn so that he would have an "extraordinary" Table for his personal use. He worked there every year from 1887 to 1892 inclusive.

Dohrn worked closely with the British Association for the Advancement of Science to get support for his endeavors. From the outset there was a Committee that dealt with the Naples Station. The annual Reports of the Association provide an excellent source of information about the history of British involvement in both supporting and using the Station. The name and composition of the Committee naturally changed a bit over the approximately forty years of its existence, but its role remained more or less the same. The membership of the Committee is shown in Table I.

Dohrn, who attended several meetings of the Association, was for some time a member of the Committee, and was identified as both Secretary and author for the first Report. He wrote some of the material that went into the other Reports as well, and furnished data on the utilization of the station, its development, and the publications that had been produced. These English-language reports overlapped to a considerable extent with the ones in German that Dohrn published in the house organ of the Station.

The Committee had two main functions. One of these was to encourage the Association to support work at the Station, mainly by providing funds for its Table. The other was to evaluate the applications of scientists who wanted to utilize the Table. Dohrn had no control over who used the Tables, although he was able to accommodate a few scientists by making other arrangements. He did have some flexibility as to scheduling and deciding which Table an investigator might occupy. For that reason the same scientist might sometimes occupy the British Association Table and some-

TABLE 1. The Naples Marine Station Committee membership

The numbers in the table correspond to that of the annual meetings of the Association in which the Report was published. Reports were sometimes published during the year of the meeting, but usually it was in the following year. Therefore the numbers are more convenient than the years. The Secretary is indicated by the corresponding number being set in **bold** type.

G. Rolleston	43 49 50 51
P. L. Sclater	43 45 47 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66
A. Dohrn	**43**
T. H. Huxley	43 45 47 49 50 51 52
W. Thompson	43 49 50 51
E. R. Lankester	43 45 47 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68
F. M. Balfour	45 47 49 50 51 52
J. Gwyn Jeffreys	45 49 50 51
M. Foster	45 47 49 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66
A. G. Dew-Smith	**45** 47 **49** 50 51
W. B. Carpenter	47 49 50 51
P. Sladen	**50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68**
G. J. Allman	51 52 53
A. Newton	52 53
A. Sedgwick	53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68
A. M. Marshall	54 55 56 57 58 59 60 61 62 63 64
A. C. Haddon	54 55 56 57 58
H. N. Moseley	55 56 57 58
J. Cossar Ewert	59 60 61 62 63 64 65 66 67
S. J. Hickson	65 66 67 68
W. C. M'Intosh	66
W. A. Herdman	67 68
W. F. R. Weldon	67 68
W. E. Hoyle	67 68

G. Rolleston	
P. L. Sclater	
A. Dohrn	
T. H. Huxley	
W. Thompson	
E. R. Lankester	69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86
F. M. Balfour	
J. Gwyn Jeffreys	
M. Foster	
A. G. Dew-Smith	
W. B. Carpenter	
P. Sladen	
G. J. Allman	
A. Newton	
A. Sedgwick	69 70 71 72 73 74 75 76 77 78 79 80 81 82
A. M. Marshall	
A. C. Haddon	
H. N. Moseley	
J. Cossar Ewert	
S. J. Hickson	69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86
W. C. M'Intosh	69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86
W. A. Herdman	69 70 71 72
W. F. R. Weldon	69 70 71 72 73 74 75 76
W. E. Hoyle	
G. B. Howes	**69 70 71 72** 73 74 75
J. E. S. Moore	**73 74**
T. R. R. Stebbing	**75 76 77 78 79 80**
G. P. Bidder	75 76 77 78 79 80 81 82 83 84 85 86
S. F. Harmer	79 80 81 82 83 84 85 86
W. B. Hardy	80 81 82 83 84 85 86
E. S. Goodrich	**81 82 83** 84 85 86
A. D. Waller	81 82 83 84 85 86
J. H. Ashworth	**84 85 86**
F. O. Bower	85 86

times one sponsored by Oxford or Cambridge. These functions of the Committee help to explain its makeup. In the first place there were influential and well known scientists whose prestige was an asset for the Committee. Many of the members were Fellows of the Royal Society of London. Some of them were very well known to the general public as well as the scientific community. Thomas Henry Huxley (1825–1895) was famous for his advocacy of evolutionary ideas and much else besides. Sir Wyville Thomson (1830–1882) was well known for his leadership in the Challenger Expedition. Many were university professors, and their prestige and that of their institutions must have been quite impressive. Secondly, the Committee largely consisted of persons with expertise in the areas of research that were expected to be carried out at the Station. Some of the younger members of the Committee seem to have been particularly interested in supporting the Station. Many of the Committee members utilized the Table themselves or else the Oxford and Cambridge Tables. They also had students who might make use of it.

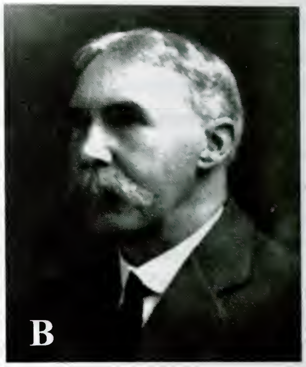
The reports of the Committee were well designed to give an impression that the Station was in flourishing condition and benefited from the support that the Association was providing. They also were designed to show that the Association was getting its money's worth. The occupants of the Tables provided accounts of their visits. These included much praise for the institution and its staff as well as preliminary reports on their research. One suspects that the occupants hoped that their reports would provide grounds for return visits.

Indeed, unpublished correspondence in the archives of the Station makes it abundantly clear that the activities of the Committee and its members were carefully planned and orchestrated, and that a great deal of maneuvering went on behind the scene. The main players here were Dohrn himself, as one might expect, and the Secretary of the Committee. [Albert George] Dew-Smith (1848–1903) was a Cambridge physiologist and partner, with Horace Darwin, in the Cambridge Instrument Company. He was the third occupant of the Cambridge Table, from February, 1874 to June 10, 1874, at the same time that the Table was occupied by Francis Maitland Balfour, the second occupant. Dew-Smith also occupied the Cambridge Table from December 15, 1875 to February 12, 1876. He was Secretary from 1876 to 1878. (Walter) Percy Sladen (1849–1900) occupied that position from 1879 to 1898. Sladen was a gentleman scholar from Halifax, York, and a largely self-taught expert on echinoderms (Anonymous 1900). As an occupant of the British Association Table from December 3, 1878 to February 16, 1879 he made important observations on the pedicellariae of these organisms (Sladen 1880). Later he monographed the asteroids of the *Challenger* expedition. Sladen sent Dohrn and his staff requests for material for the Reports, drafts of Reports, and accounts of the negotiations in which he was involved.

There was a minor crisis with respect to funding when, at the Aberdeen meeting in 1885, the Association cut its support from £100 to half that amount. There seems to have been some sentiment among the membership of the Association that the Plymouth Laboratory diminished the need for support of the Naples Station. The Committee protested and pointed out that the Table was occupied only thanks to Dohrn's patient forbearance. Again, at the Leeds meeting in 1890 the Committee of Recommendations did not approve the usual sum. The situation was saved when one of the members of that Committee, a Captain Noble, offered to provide the £100 out of his own pocket. One stratagem that Sladen used was to announce the appointment of future Table occupants before the grant had been approved at the meeting. Obviously it would be embarrassing to the Association if it did not provide the grant.

It seems obvious that the Oxbridge Tables had a different kind of institutional support than that of the British Association, and therefore somewhat different problems getting funded. So far as Cambridge goes, at least, a great deal of light is cast upon the workings of the system through the correspondence between Harmer and Dohrn, during the period from May 24, 1889 to October 12,


A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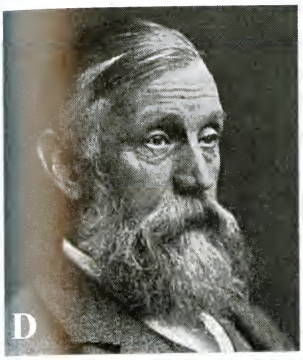
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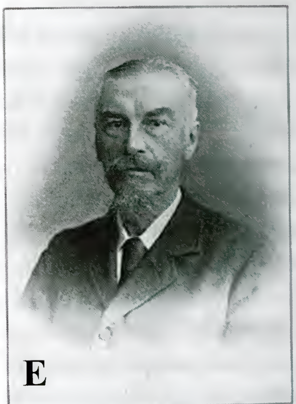
E

P. L. Sclater.


F


G


H

A. George Rolleston 1829–1881
B. James Cossar Ewart 1851–1933
C. James Hartley Ashworth 1874–1936
D. Michael Foster 1836–1907
E. Philip Lutley Sclater 1929–1913
F. William Benjamin Carpenter 1813–1885
G. William Carmichael (McIntosh) (n.d.)
H. Walter Frank Raphael Weldon 1860–1906

Images courtesy of the Historical Archives of the Stazione Zoologica Anton Dohrn (Naples Zoological Station)

1910, when the former was doing most of the administrative work. A major goal of the correspondence was to inform Dohrn of who had been nominated, and to get Dohrn's approval, especially when extraordinary arrangements were made, such as allowing two persons to occupy the Table at the same time. Incidentally, Harmer provided a substantial amount of information about the nominees' qualifications and intended research. The decision as to whom to nominate was made by a committee called the "Special Board."

Another important topic for the correspondence was to arrange for the University to provide

an annual grant of £100, supplemented by another £50 in support of the Table occupants themselves. The grant had to be renewed every five years, with the approval of the Senate of the University. There was always some opposition, as is clear from a letter from Bidder to Dohrn, dated April 6, 1893, from Parker's Hotel in Naples. Bidder was sending Oscar Brown, Fellow of Kings College and a lecturer on history, to meet Dohrn. Brown wanted the money spent not on the Station, but on history. Bidder remarked "He is by no means a fool." Brown was fond of Goethe and considered modern scientific men devoid of culture. Dohrn, who was as fond of Goethe as anybody, was anything but devoid of culture, and Bidder obviously had that in mind.

The extent to which the Table was used and the performance of those who occupied it were important considerations in the deliberations as to whether to renew the grant. There seems to have been little difficulty in getting the grant renewed in 1891, 1896, or 1901, but around that time Harmer seems to have become a bit pessimistic. In a letter to Dohrn, dated March 8, 1901, Harmer expresses considerable dissatisfaction with the performance of the men who had been sent over during the previous five years. Dohrn was evidently quite concerned, for in a long letter to Harmer, dated April 18, 1901, he provided a detailed enumeration of the Table occupants and their performance. Stead, for example, had worked on annelids, but published nothing and become a school teacher. On the other hand, Punnet's work on elasmobranch nerves had been published in the Proceedings of the Royal Society of London. Harmer responded in a letter to Dohrn, dated April 24, 1901, apologizing for giving the impression that the fault lay with the Station; he was only concerned about justification of the grant. He observed that quite a number of talented young men had been able to obtain grants for travel to the tropics and elsewhere. And he remarked that students able to assimilate the work of others were often at a loss when they had to do research on their own. He said that the opponents of the grant had complained about the Table being used only for zoologists, and wondered what could be done to get physiologists and botanists involved.

Five years later, Harmer was downright pessimistic. In a long letter to Dohrn, dated June 6, 1905, he expressed disappointment with the last five years. There were not enough applicants to fill the places. One reason was that people like J. S. Gardiner had been able to arrange for their own expeditions. But the more likely cause was "the great interest which has been taken here in Mendel's work." It must have come as a great relief to both of them when the University Senate did renew the grant. On October 12, 1910, the year after Anton Dohrn's death Harmer wrote to his son Reinhard Dohrn, saying that he could not help much because he would not be at meetings where he would have influence, but that he would write the Professor of Zoology, J. Stanley Gardiner. Again he explained that the dropoff had been mainly due to the influence of Mendel's work. Bateson had been trying to redirect everything to genetics. The same problems seem to have afflicted Oxford. E.S. Goodrich, in a letter to Reinhard Dohrn dated December 1, 1913 remarked: "So many young zoologists have been diverted to Mendelism & other special studies that it is quite difficult to find a sufficient number to fill the various Tables at seaside laboratories." And in spite of Harmer's efforts no Cambridge physiologists or botanists ever got interested. Nonetheless the grant was renewed, and the Cambridge, Oxford and British Association Tables continued to be used until the beginning of the war.

In some ways the most important English participant in the early days of the Station was Edwin Ray Lankester (1847–1929), who became a friend of Dohrn when both were studying under Ernst Haeckel at Jena (see Lester and Bowler 1995; Ghiselin 1996). While the station was getting started Lankester spent the winter of 1871 to 1872 with Dohrn in Naples. He published a paper based on miscellaneous observations made at that time mainly having to do with evolution and development (Lankester 1873). Later he sent his students to work at the Station. The two evolutionary comparative anatomists formed a sort of alliance, one that is most evident in the publica-

tions that they edited. In the first place there was the Station's house organ, *Mittheilungen aus der Zoologischen Station zu Neapel*. There was also a monograph series entitled *Fauna und Flora des Golfes von Neapel*. The monograph series was intended to help support the activities of the Station, with the sale of one monograph subsidizing the sale of the next. Lankester took over the editorship of the important periodical the *Quarterly Journal of Microscopical Science*, which had been edited by his father. Work done at Naples by Lankester's students and other English zoologists provided a substantial amount of the contents of the journal, and that tradition continued when Lankester's student Edwin S. Goodrich took over as editor (G.C. Bourne 1919). Lankester was for some time a professor at Oxford as was Goodrich later on. Lankester and his students were largely responsible for the content of the *Oxford Natural History*, an important reference work. There was a rival *Cambridge Natural History*. Oxford was more enthusiastic about Darwinism than Cambridge was.

The monograph series was an important activity of the Zoological Station and many of the people who worked there were monographers. The taxonomic monograph is a kind of literary genre, and it may help to explain what a monograph is supposed to accomplish. Charles Darwin's *A Monograph on the Sub-Class Cirripedia, with Figures of all the Species*, is a particularly good example (Darwin 1851–1855). So is Dohrn's own monograph on the Pantopoda or Pycnogonida (Dohrn, 1881). Such works typically begin with a summary of what is known about the group of interest, then provide a description of the relevant anatomy, species descriptions, a revised classification, and generally some discussion of the broader implications of the research.

It is interesting that only one of the monographs was written by an Englishman, Geoffrey Watkins Smith (Anonymous 1914). This was a monograph on the Rhizocephala, a group of parasitic animals rather obscurely related to the barnacles to which Darwin devoted some eight years of research (Smith 1906). As part of his research for the monograph Smith visited various museums in order to examine specimens. Letters to Dohrn, dated September 4 and 14, 1905 indicate that Dohrn acceded to Smith's request for financial support for a visit to the museum in Copenhagen. Work on the monograph was not simply a matter of exploring the fauna, however. It was background to further research that he did on crustacean sexuality (Smith 1910a, 1910b, 1911, 1913).

Smith was born at Beckenham, Kent on October 9, 1881. As a student at Oxford, he worked under W.F.R. Weldon, who in turn had been a student of Lankester and Balfour, and succeeded Lankester as professor at University College in 1890 before moving to Oxford in 1900. Smith and Weldon co-authored the chapter on Crustacea in the *Cambridge Natural History* (Smith and Weldon 1909). However, it was a posthumous arrangement made after Weldon's untimely death on April 13, 1906). Weldon's early work on crustacean morphology led him into studies of variation in natural populations and he made important contributions to the study of evolutionary mechanisms (he was a biometrician rather than a Mendelian). Smith, after working at Naples from 1903 to 1905, returned to Oxford, where he succeeded G.C. Bourne. As already mentioned, he continued to work at Naples. He was there from March 27 through April 6, 1914. An officer in the British army, he died in France on July 10, 1914.

There were no American monographers at all. Does this have something to do with the English language or Anglo-Saxon culture? Probably not; the low representation is much easier explained in terms of the distance from Naples and the kinds of scientific projects that were feasible. If one is going to prepare a thorough treatment of a faunal or floral element of the Gulf of Naples, it really helps to have access to the organisms over a protracted period of time. Systematists can work largely with preserved materials in museums with perhaps occasional trips to the shore to observe the living ones. But if the organisms are to be collected extensively or studied much in the living state, it is much better to reside where they occur for substantial periods of time.

Smith (1906) remarked that he spent three years at the Station. It was natural, therefore, for Dohrn and his assistants to produce monographs. That helps to account for the relatively large number of Germans among the monographers, but just a little. Their access to reliable support for Tables was probably more important. By the same token, it was convenient for Italian scientists, especially those who resided in Naples and who occupied Tables, to undertake that kind of research. One Italian, Battista Grassi, seems to be an exception in that he spent very little time at the Station. However, the animals that he monographed, the Chaetognatha, are almost all pelagic and therefore widely distributed, so that although they occur at Naples there is no local fauna that needed special attention. He did most of his work at Messina. Likewise, the Russian Uljanin, who worked on *Doliolum,* a pelagic tunicate, worked largely at Villefranche-sur-Mer, where the Russians had their own establishment.

At any rate, of the approximately 33 monographs published before the First World War, 7 (about 20%) were written by Italian and 24 (about 70%) by German-speaking scientists. This disparity is considerably diminished when one compensates for the larger number of scientists. The Germans, Austrians and others who wrote in that language were numerous enough that the figure is not disproportionate. However, the Italians, with 25 percent of the Tables, produced 20% of the monographs, and the British with 7% of the Tables produced about 3% of the monographs. Granted that a sample size of one is not very significant, the Italians were nonetheless considerably more prolific of monographs than the English were. Some of the English scientists who worked at the Station at the time did the kind of systematic research that goes into monographs. One of these was Arthur William Waters, about whom I know very little, except that he was from Manchester and occupied the British Association Table at the Station from November 13 to December 30, 1875 and from October 13 to December 1, 1879. He published a monograph on the Bryozoa of the Gulf of Naples as three short papers in the *Annals and Magazine of Natural History* (Waters 1899).

A more important systematist who spent time at the Station was William Abbott Herdman (1858–1924), who was Derbey Professor of Natural History in the University of Liverpool from 1881 to 1919. He was a member and Chairman of the British Association's Committee and occupied its Table from March 19 to April 9, 1900. He gives a good account of his visit (Herdman 1900). Herdman was an important student of tunicate systematics and phylogeny. Liverpool had its own marine laboratory and its own series of publications, to which he was a major contributor. Work at Liverpool was largely focused on the local biota and in that sense its laboratory did not compete much with the one at Naples. Much the same may be said of the Plymouth laboratory on England's southern coast. The situation with the English was in that respect not much different from that of the Americans. Furthermore, the English were also much involved in the work of the *Challenger* Expedition, which explored the deep sea from December 21, 1872 to May 24, 1876. Herdman worked as an assistant to Charles Wyville Thomson in efforts to get the extensive collections from that expedition worked up by specialists and published. The Zoological Station was only marginally involved in marine exploration beyond its own faunal province. It did participate in training Italian naval officers to collect materials. It also attempted to establish a laboratory at Ralum in New Britain, but withdrew because it was not a feasible project (Groeben 2004).

Some other systematists fit the pattern of Herdman. Their geographical interests lay elsewhere and they went to Naples to get comparative material. H.M. Kyle worked on the classification of flatfishes, and took advantage of a visit to the Station to study a species that he considered a transitional form (Kyle 1900). Anna Vickers (1852–1906) was working on a monograph of Barbados algae. She was at the Station from April 3 to May 26, 1897, from October 13, 1899 to January 1, 1900, from January 8 to April 18, 1902, and from December 24, 1903 to April 15, 1904. In 1902, she was able to study living material as well as specimens that she brought with her (Vickers 1903).

Much of the research that English zoologists did at the Station had to do with phylogenetics and classification at the higher taxonomic levels. Furthermore there was an intellectual tradition, one might even say a school, that can be traced back to the early interaction between Dohrn and Lankester. It also involved Francis Maitland Balfour (1851–1881), who did his classical research on the development of elasmobranches, a group that interested Dohrn very much, during a period of two years beginning around the time that the Station opened. Dohrn's approach to phylogenetics involved his principle of the succession of functions, which involved a search for physiological continuity (Dohrn 1875; for translation and commentary see Ghiselin 1994). He hypothesized that the vertebrates are descended from annelids. This idea was heretical at the time, but it was nonetheless taken seriously. That particular relationship aside, the same general approach could be used to study the evolution of various structures. One group of structures was the secondary body cavity, or coelom. Lankester was very much interested in this topic and so was his student already mentioned, Edwin S. Goodrich (1868–1946), who succeeded him as Linacre Professor of Comparative Anatomy at Oxford and also took over as Editor of the *Quarterly Journal of Microscopical Science* and served in that post for many years. Goodrich himself visited the Station repeatedly. He published a paper on the coelom in 1895 and a much longer one in 1945 (Goodrich 1895, 1945). His many, but rather brief, visits in the interim provided much documentation.

Lankester's and Goodrich's students, as well as students of other English zoologists, went to Naples to work on projects that to some extent form part of this tradition. Much of their work was published in the *Quarterly Journal of Microscopical Science*. One of Lankester's students, J.T. Cunningham (1883) worked on the embryology of the gastropod *Patella* (see also Cunningham, 1883). John Dow Fisher Gilchrist (1866–1926) was interested in the pallial organs of opisthobranch gastropods (see Gilchrist 1894). After completing his undergraduate work at Edinburgh, Gilchrist became a student of Arnold Lang (1855–1914) in Zürich (Amodio 1977). Lang had been one of Dohrn's assistants from 1878 to 1885, before receiving the call to Jena as the first Ritter professor of phylogenetics. He remained at Jena until 1889, when he accepted the call to Zürich. Gilchrist received his doctorate under Lang and became a professor of zoology at Capetown. Alfred Gibbs Bourne was a student of Lankester who worked on annelids. (Alfred Gibbs Bourne, who accepted an academic post in Madras, India in 1885, should not be confused with Gilbert C. Bourne, another of Lankester's students, who worked on Porifera, Cnidaria and Mollusks.) During his first visit, from January 3 to April 14, 1882, he made miscellaneous observations at that time and also checked Lankester's observations on squid development, which had been criticized by M. Ussow (A.G. Bourne 1883). His second visit, from November 1, 1883 to April 14, 1884 seems to have been more productive of results on annelids than the former (A.G. Bourne 1885). In this case he made some observations for Lankester having to do with the circulatory systems of mollusks.

Quite a number of English scientists who were interested in phylogenetic topics went to Naples to find material that was more readily available there than elsewhere. These include John Beard (1884) on the Myzostomida, Harmer (1891) on bryozoans, MacBride (1892) on various echinoderms, and Minchin (1892) on sponges. Arthur Willey (1867–1942) made a career of traveling to remote places seeking out animals that were considered primitive (Kerr 1944). A student of Lankester, he occupied Tables at the Station from July 14 to August 2, 1889 and from October 8, 1891 to August 27, 1892. While there he did important research on "lower" chordates. He later set out on an expedition to more remote areas seeking animals that do not occur at Naples, especially the pearly *Nautilus*. He was welcomed at the Station on the way, but did not see Dohrn at that time.

The notion that comparative anatomy and embryology from an evolutionary point of view ceased to be studied at the turn of the century is an academic myth. It is true, however, that other

topics became more fashionable and that there was a great expansion of experimental and physiological research. The picture at Naples is complicated by the fact that the original laboratory facility was constructed primarily for morphological and systematic research. A physiological laboratory was opened in 1888, approximately doubling the amount of space available at the Station.

Goodrich's student, Julian S. Huxley (1887–1975), occupied a Table from October 21, 1909 through July 15, 1910. In a letter to Dohrn dated 22 November 1906, Geoffrey Watkins Smith, whom we have discussed previously, mentioned the young Huxley's approaching arrival at Oxford, though he had not met him yet. Smith's former tutor, G.C. Bourne, had been appointed to the professorship formerly occupied by Weldon. Smith now replaced Bourne as tutor, and Smith became Huxley's tutor. We may remember that Smith died in 1914. Huxley became his replacement in 1919.

Huxley, as is generally known, ultimately became one of the architects of the Synthetic Theory. One naturally wonders whether, or to what extent, Goodrich was responsible for that. The question is of some interest because of my rather unpopular thesis that morphology contributed little or nothing to that version of Darwinism (Ghiselin 1980, 2006). One argument against my view has been that Goodrich contributed to the Synthesis because he was the teacher of the younger Huxley. But Huxley's research, at the Zoological Station and elsewhere, was at most an outgrowth of the morphological tradition, not a contribution to what might be called evolutionary morphology. In his autobiography Huxley (1970) says that one of the Assistants, Paul Mayer, suggested that he work on regeneration during his period at Naples. He did, and the work was quite successful, though it is a far cry from the kind of comparative anatomy and embryology that interested Darwin, Dohrn, Lankester and Goodrich. On the other hand, maybe there was some influence from Smith, whom Huxley characterizes as "brilliant." That would provide a link, via Weldon, with the kind of evolutionary biology that really did get assimilated in the Synthesis.

Acknowledgments and Sources

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Literature Cited

Anonymous ("G.B.H."). 1900. Walter Percy Sladen. *Nature* 62:256–257.

Anonymous. 1914. Geoffrey Watkins Smith. *Nature* 97:502.

Amodio, Camillo Renato. 1977. *Der Zoologe Arnold Lang (1855–1914)*. Juris Druk + Verlag Dietikon, Zürich, Switzerland. 378 pp.

Beard, John. 1884. On the life-history and development of the genus *Myzostoma* (F. S. Leuckart). *Mittheilungen aus der Zoologischen Station zu Neapel* 5:544–580 (Pl. 31–32).

Bourne, Alfred Gibbs. 1883. Report on the occupation of the Table. *Report of The British Association for the Advancement of Science* 52:290–291.

Bourne, Alfred Gibbs. 1885. Report on the occupation of the Table. *Report of The British Association for the Advancement of Science* 54:254–256.

Bourne, Gilbert Charles. 1919. Fifty years of the 'Quarterly Journal of Microscopical Science' under the editorship of Sir E. Ray Lankester, K.C.B., M.A., D.Sc., LL.D., F.R.S. *The Quarterly Journal of Microscopical Science* 64:1–17.

Cunningham, J.T. 1883. The renal organs (nephridia) of *Patella*. *Quarterly Journal of Microscopical Science* 23:369–375.

CUNNINGHAM, J.T. 1883. Notes on the structure and relations of the kidney in *Aplysia*. *Mittheilungen aus der Zoologischen Station zu Neapel* 4:420–428, pl. 30.

DE MASI, DOMENICO. 1998. *La Fabbrica della Scienza*. IBM, Milano, Italy. 16 pp.

DARWIN, CHARLES. 1851–1855. *A Monograph on the Sub-Class Cirripedia, with Figures of all the Species*. 2 vols. The Ray Society, London, UK.

DOHRN, ANTON. 1875. *Der Ursprung der Wirbelthiere und das Prinzip des Functionswechsels*. Wilhelm Engelmann, Leipzig, Germany. xv + 87 pp.

DOHRN, ANTON. 1881. *Die Pantopoden des Golfes von Neapel und der angrenzenden Meeres-Abschnitte. Fauna und Flora des Golfes von Neapel, III*. Wilhelm Engelmann, Leipzig, Germany. vii + 252 pp., pls. 1–17.

FISCHER, JEAN-LOUIS. 1980. L'aspect social et politique des relations épistolaires entre quelques savants français et la Station Zoologique de Naples de 1878 à 1912. *Revue d'Histoire des Sciences* 33:225–251.

FOKIN, SERGEY I, 2006. *Russian Scientists at Naples*. Aletheia, Saint Petersburg, Russia. 380 + 32 pp. (In Russian.)

GHISELIN, MICHAEL T. 1980. The failure of morphology to assimilate Darwinism. Pages 180–193 *in* E. Mayr and W.B. Provine, eds., *The Evolutionary Synthesis*. Harvard University Press, Cambridge, Massachusetts, USA.

GHISELIN, MICHAEL T. 1994. The Origin of Vertebrates and the Principle of Succession of Functions: Genealogical Studies by Anton Dohrn, 1875. An English translation from the German, introduction and bibliography. *History and Philosophy of the Life Sciences* 16:3–96.

GHISELIN, MICHAEL T. 1996. [Review of] Rediscovering the science of the history of life. E. Ray Lankester and the Making of Modern British Biology, by Joseph Lester and Peter J. Bowler. *History and Philosophy of the Life Sciences* 18:123–128.

GHISELIN, MICHAEL T. 2002. Russian scientists at the Naples Zoological Station. Pages 94–100 *in* E.I. Kolchinsky, ed., *Between Science and Ideology*. Russian Academy of Sciences, Saint Petersburg Branch of the Institute for the History of Science and Technology, Saint Petersburg, Russia.

GHISELIN, MICHAEL T, 2006. The failure of morphology to contribute to the modern synthesis. *Theory in Biosciences* 124:309–316.

GHISELIN, MICHAEL T., AND CHRISTIANE GROEBEN. 2000. A bioeconomic perspective on the organization of the Naples marine station. Pages 273–285 *in* M.T. Ghiselin and A.E. Leviton, eds., *Cultures and Institutions of Natural History: Essays in the History and Philosophy of Science.* Memoir 25, California Academy of Sciences, San Francisco, California, USA.

GILCHRIST, JOHN D.F. 1894. Report on the occupation of the table. *Report of the British Association for the Advancement of Science* 63:540–542.

GHIRETTI, FRANCESCO. 1985. Comparative physiology and biochemistry at the Zoological Station of Naples. *Biological Bulletin* 168(Supplement):122–126.

GOODRICH, EDWIN S. 1895. On the coelom, genital ducts, and nephridia. *Quarterly Journal of Microscopical Science* 37:477–510, pls. 44–45.

GOODRICH, EDWIN S. 1945. The study of nephridia and genital ducts since 1895. *Quarterly Journal of Microscopical Science* 86:113–392.

GROEBEN, CHRISTIANE. 1982. Charles Darwin 1809–1882, Anton Dohrn 1840–1909: Correspondence. Macchiaroli, Napoli, Italy. 118 pp.

GROEBEN, CHRISTIANE. 1995. *Der Freskensaal der Stazione Anton Dohrn: Biographie eines Kunstwerkes*. Macchairoli, Napoli, Italy. 78 pp.

GROEBEN, CHRISTIANE. 2004. Impact of travels on scientific knowledge: Ralum (New Britain): A research station (1894–1897) sponsored by the Naples Zoological Station. Pages 57–76 *in* M.T. Ghiselin and A.E. Leviton, eds., *Impact of Travels on Scientific Knowledge. Proceedings of the California Academy of Sciences*, ser. 4, 55(Suppl. II)(6).

GROEBEN, CHRISTIANE, AND MICHAEL T. GHISELIN. 2001. The Zoological Station at Naples and its impact on Italian zoology. Pages 321–347 *in* A. Minelli and S. Casellato, eds., *Giovanni Canestrini, Zoologist and Darwinist*. Istituto Veneto di Scienze, Lettere ed Arti, Venezia, Italy.

HARMER, SYDNEY F. 1891. On the nature of the excretory process in marine Polyzoa. *Quarterly Journal of*

Microscopical Science 33:123–167, pls. 2–3.

HERDMAN, WILLIAM A. 1900. Report on the occupation of the British Association Table at Naples during March and April 1900. c. Observations on compound ascidians. *Report of the British Association for the Advancement of Science* 17:384–386.

HEUSS, THEODOR. 1991. *Anton Dohrn: a Life for Science*. Springer-Verlag, Berlin, Germany. xxxvi + 401 pp.

HUXLEY, J. 1970. *Memories*. Harper & Row, New York, New York, USA. 296 pp.

KERR, JOHN GRAHAM. 1944. Arthur Willey, 1867–1942. *Obituary Notices of the Fellows of the Royal Society of London* 4:394–410.

KÜHN, ALFRED. 1950. Anton Dohrn und die Zoologie seiner Zeit. *Pubblicazioni della Stazione Zoologica di Napoli*, Supplemento:1–205.

KYLE, H.M. 1900. Report on the occupation of the British Association Table at Naples, from October to December 1899–1900. a. The anatomy of the Flatfishes (Heterosomata). *Report of the British Association for the Advancement of Science* 17:383.

LANKESTER, E. RAY. 1873. Summary of zoological observations made at Naples in the winter of 1871–72. *Annals and Magazine of Natural History* (4)11:81–97.

LESTER, JOSEPH, AND PETER J. BOWLER. 1995. E. Ray Lankester and the Making of Modern British Biology. *British Society for the History of Science*. v + 220 pp.

LINSKENS, H.F. 1975. 100 jaar Nederlandse werktavel aan het Zoölogisch Station te Napels. *Vakblad voor Biologien* 7:102–111.

MACBRIDE, ERNEST W. 1892. The development of the genital organs, ovoid gland, axial and aboral sinuses in *Amphiura squamata*; together with some remarks on Ludwig's haemal system in this ophiuroid. *Quarterly Journal of Microscopical Science* 34:129–153, pls. 16–18.

MAIENSCHEIN, JANE. 1985. First impressions: American biologists at Naples. *Biological Bulletin* 168(supplement):187–191.

MINCHIN, EDWARD A. 1892. The oscula and anatomy of *Leucoselenia clathrus*. *Quarterly Journal of Microscopical Science* 34:477–495, pl. 29.

MIZOGUCHI, HAZIME. 1998. Japanese biologists at the Naples Zoological Station, 1887–1956. *Historia Scientiarum* 8:99–113.

MONROY, ALBERTO, AND CHRISTIANE GROEBEN. 1985. The "new" embryology at the Zoological Station and at the Marine Biological Laboratory. *Biological Bulletin* 168(Supplement):35–43.

MÜLLER, IRMGARD. 1996. The impact of the Zoological Station in Naples on developmental physiology. *International Journal of Developmental Biology* 40:103–111.

ORLOV, SERGEI. 2001. Biologists of Russia and Germany and the birth of marine zoological stations. Pages 55–67 *in* E.I. Kolchinsky, ed., *Russian-German Links in Biology and Medicine*. Russian Academy of Sciences: Saint Petersburg Branch of the Institute for the History of Natural Sciences and Technology, Saint Petersburg: Russia. (In Russian.)

PARTSCH, KARL JOSEF. 1980. *Die Zoologische Station in Neapel. Modell internationaler Wissenschfatszusammenarbeit*. Vandenhoeck & Ruprecht, Göttingen, Germany. 369 pp.

SANTINI, LEA RITTER, AND CHRISTIANE GROEBEN, EDS. 2005. *Arte come Autobiografia/Kunst als Autobiographie*. Gaetano Macchiaroli Editore, Napoli, Italy. 395 pp.

SLADEN, W. PERCY. 1879. Report on the occupation of the Table. *Report of the British Association for the Advancement of Science* 49:167–169.

SLADEN, W. PERCY. 1880. On a remarkable form of pedicellaria, and the functions performed thereby; together with general observations on the allied forms of this organ in the Echinidae. *Annals and Magazine of Natural History*, ser. 5, 6:101–114, pls. 12–13.

SLOAN, JAN BUTIN. 1978. The founding of the Naples Table Association for Promoting Scientific Research by Women. *Signs* 4:208–216.

SMITH, GEOFFREY. 1906. *Rhizocephala. Fauna und Flora des Golfes von Neapel, XXIX*. R. Friedländer & Sohn, Berlin, Germany. viii + 140 pp., pls. 1–12.

SMITH, GEOFFREY. 1910a. Studies in the experimental analysis of sex. Part 1. On Mendelian theories of sex. Part 2. On the correlation between primary and secondary sexual characters. *Quarterly Journal of Microscopical Science* 54:577–604, pl. 30.

SMITH, GEOFFREY. 1910b. Studies in the experimental analysis of sex. Part 3. Further observations on parasitic castration. *Quarterly Journal of Microscopical Science* 55:225–240.

SMITH, GEOFFREY. 1911. Studies in the experimental analysis of sex. Part 7. Sexual changes in the blood and liver of *Carcinus maenas*. *Quarterly Journal of Microscopical Science* 57:251–265.

SMITH, GEOFFREY. 1913. Studies in the experimental analysis of sex. Part 10. The effect of *Sacculina* on the storage of fat and glycogen, and on the formation of pigment by its host. *Quarterly Journal of Microscopical Science* 59:267–295.

SMITH, GEOFFREY, AND W.F.R. WELDON 1909. Crustacea. Pahes 1–217 *in* S.F. Harmer and A. E. Shipley, eds., *The Cambridge Natural History*, vol. 4. Macmillan, London, UK.

VICKERS, ANNA 1903. Report on the occupation of the Table during April and May 1902. c. On the Algae of the Bay of Naples. *Report of the British Association for the Advancement of Science* 72: 262–263.

WATERS, ARTHUR WILLIAM. 1899. On the Bryozoa of the Gulf of Naples. *Annals and Magazine of Natural History*, ser. 5, 3: 28–43, 192–202, 267–281.

ZOTTOLI, STEVEN J., AND ERNST-AUGUST SEYFARTH. 1994. Julia B. Platt (1857–1935) pioneer comparative embryologist and neuroscientist. *Brain Behavior and Evolution* 43:92–106.

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Russian Biologists at Villafranca

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This article provides a brief historical review and analysis of the development of the Russian Zoological Station at Villafranca (Villfranche-sur-Mer) and information about some of the Russian scientists who worked at the Station. A majority of the archival materials used in this study, including those from the Russian part of the archives of the Villafranca Zoological Station as well as documents from several private collections, have not been previously studied. The present essay embraces the period from the foundation of the Station and some previous events (1879-1886) to the time when the Station passed completely under the jurisdiction of France (1931).

The publication of Charles Darwin's *The Origin of Species* (1859) opened a new era in the natural sciences. It stimulated a proliferation of zoological, comparative anatomical, and especially embryological investigations that often sought to prove or to disprove the new theory. Anatomical, comparative morphological, and embryological studies of marine animals were important for understanding the origin and phylogenetic relationships of the main lower animal groups, and that was one of the main reasons why scientists were suddenly concerned with the marine fauna. It was a time when zoology acquired ideological significance, and some scientific results were passionately debated in society. Marine studies also had an applied aspect, determined by economic reasons. Thus, in the last third of the 19th century, time itself dictated an interest in marine zoological research (Schmalhausen 1937; Blyakher 1955; Poljansky 1955; Müller 1975; Fantini 2002; Fokin 2006).

In the 1850–1870s, both Western European and Russian naturalists privately conducted zoological investigations at sites along the Mediterranean Sea (Messina, Naples, La Spezia, Villefranche-sur-Mer–Villafranca, Marseille, Banyuls-sur-Mer) as well as at some other marine locations. Though these researches proved highly productive in many respects, they highlighted a need for permanent biological stations, which later were founded at most of the places mentioned. By the beginning of the period under consideration, marine biological stations already existed along the Atlantic coast of France at Concarneau (1859) and Arcachon (1867). The Naples Zoological Station was also about to be founded (1872–1873), partly due to the moral support of some Russian naturalists (Müller 1975; Heuss 2000; Ghiselin 2002; Fokin 2006). Furthermore, in 1871, the first Russian biological station was established at Sevastopol (Black Sea, Russia).

Investigations of marine invertebrates, especially those of uncertain origin and phylogenetic relationships, were greatly inspired by the discoveries of A.O. Kowalevsky and I.I. Metschnikoff, two prominent Russian zoologists who worked mainly at Messina and Naples, but also at several other places along Mediterranean coast, including Villafranca (Villa-Franca) (Dogiel 1945;

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Blyakher 1955; Poljansky 1955; Fokin 2006). The development of zoology and biology in general required stable and reasonably comfortable working conditions at the stations, something that the enthusiasts of field biology had previously lacked, especially in Russia.

By the early 1870s, Russia possessed all the necessary prerequisites for the foundation of marine biological stations. There were eight universities of considerable scientific potential and an active Imperial Academy of Sciences in St. Petersburg. There were vast and poorly explored territories with five seas (the Black, Azov, Baltic, White, and Barents) just in the European part of the Empire. Marine stations were a vital necessity. They were founded owing to the efforts of several prominent scientists and scientific societies, especially those in Novorossiysk (Odessa) and St. Petersburg universities. Among the active persons was Alexis (Alexey – Russ.) A. Korotneff (1852–1915), who established the only Russian biological station outside of Russia — in the South of France, at Villafranca. On the other hand, the development of marine stations in Russia itself was a long and painful process, encumbered by the usual poor financing of science and red tape. However, as a result of personal initiative and deep concern of scientists, and with some help from the state and private donations, good results were achieved. Before World War I, Russia owned three first-rate marine stations: one at Villefranca along the Mediterranean Sea, a second at Sevastopol bordering the Black Sea, and a third, the Murman Station, along the Barents Sea. The latter was founded, in fact, at the White Sea under the aegis of the Solovky Monastery (1881) but was transferred to the Murman in 1899 (see Fokin et al. 2007).

In the present article we focus on the Station in Villafranca during the Russian period of activity — up to 1931 when it passed completely under the jurisdiction of France. The aim is to provide a brief historical review and analysis of development of the Station and some information about the Russian scientists who worked there. This topic has not been carefully treated earlier either by historians in Russia, which owned and managed the Station for more than 40 years, or in English-speaking countries except for the limited amont of information provided by Kofoid (1910). Tregouboff (1983), the Station's last Russian director, published the only large review of the Station's history, but he did it in quite an unfair manner. Unfortunately, a lot of materials, which were used by him (first of all over 60 letters addressed to the Station from 1915 to 1931), have disappeared. In other short indications about the Russian Station in Villafranca made by several scientists in print or via the Internet (Caullery 1950; Braconnot et al 2004; *<http://www.darse.org/v1/ sciences/fol; http://www.obs-vlfr.fr/historique.php>*), various mistakes or unclarities are presented.

Russian biologists at Villafranca before the foundation of the Russian station

The vision for a station in Villefranche had deep roots. Long before the Russian Station's foundation, Villefranche harbor was known to be a convenient site for marine biological research, especially on planktonic animals. The famous naturalist Carl Vogt (1817–1895) worked there as early as the 1840–1850s; F. Peron (1775–1810) and C.A. Lesueur (1778–1846) discovered rich planktonic marine life near by Nice even before — in 1809 (Braconnot et al. 2004); and. Russian biologists Ph.V. Ovsjannikow, N.P. Wagner, M.C. Voronin, V.N. Ulyanin, A.P. Bogdanov, A.O. Kowalevsky, I.I. Metschnikoff, M.S. Ganin, M.M. Ussow, W.W. Salensky, A.A. Korotneff, M.M. Davidoff, V.M. Repyahoff and some others also visited this part of the Mediterranean coast, which up to 1860 belonged to the Sardinian kingdom and then to France. Actually, A.A. Korotneff, the future founder of the Station, had visited Villafranca for the first time in 1874 as a student in company with his teacher, Prof. Bogdanov. A number of scientists from Western countries also worked there.

Other zoologists before Korotneff attempted to settle in Villafranca. The well-known Russian

zoologist and embryologist Alexander O. Kowalevsky (1840–1901), who on two occasions spent several months in Nice, Villafranca, and Beaulieu St. Jean (1878/79, 1882), wrote in February 10, 1879 to Iliya I. Metschnikoff (1845–1916) in Odessa:

> I was asked what is your opinion about the possible foundation of a zoological station here, in Villafranca, which could be supported by the Russian government? Are you ready to petition for such founding from the government? I have written to Ovsjannikow[1] for this matter and by myself I am very sympathetic to this idea to create a station in Villafranca. The sea here is rich indeed, not less than in Naples. But swimming animals are better and fresher, since they are swimming directly in front of the windows of the laboratory — just take it. Barrois petitions to get the same amount of money as was done for Naples or, at least half — namely about 2000 francs. I would think we could write a joint letter to Ovsjannikow. Then he can petition through the Academy. Bogdanov (Anatol) agrees with that. What about you? (Letters of A.O. Kowalevsky to I.I. Metschnikoff, p. 117).

From this letter it is clear that some "preliminary" laboratory already existed at Villafranca in 1879, and, apparently, its main organizer and manager was Jules Barrois (1852–1943), zoologist from Lille University. We do not know what was the original location of the laboratory. Because financial support from the Russian government was not promised at that time, Barrois sought to get money from other resources. Shortly thereafter, in 1881, Barrois together with Hermann Fol (1845–1892), a professor of Geneva University, received some support for the marine laboratory from the French Ministry of Public Education, the Ministry of Agriculture, Community of Villefranche, and, lastly, from Oxford University and the Naturalistic Society of Geneva. Officially the Laboratory opened in November 1881, as was described in the report "Plan for reorganisation of the laboratory in Villefranche (Nice)" by Barrois and Fol (1887). The Laboratory was located in the vacated premises of the Russian field hospital — two small houses-towers (pavilions) of "lazaret" (Barrois and Fol 1887; Kofoid 1910; Braconnot et al. 2004). However, the official agreement about using those pavilions was made only in the beginning of 1883. In the meantime, during an outbreak of cholera, the buildings once again served as a hospital. And Barrois and Fol's decision to build a new station following that event was never carried out (Koltzoff 1915); thus, in 1884 they moved to "Russian house", which Prof. Korotneff had gotten for the Russian Station. It is interesting that in their report Barrois and Fol simply ignored the fact that "Russian house" was donated not for them, but for Korotneff! They just mentioned in the text that the document giving permission to use the building as a station arrived in April 1884 from St. Petersburg, Russia (Barrois and Fol 1887, §3- Péripéties des locaux).

Nevertheless, even at the beginning, Barrois had planned to develop an international station. He wrote about this idea to Charles Darwin in March 1882:

> The French government had decided in the recent time to establish the natural laboratory in Villefranche, near by Nice in aim to provide for numerous naturalists and foreigner scientists, who visited this place before, a good opportunity to work… I am writing you these few words with a hope to get back a letter with your sympathy and approval of this idea of the international marine laboratory at Villefrance" (Barrois 1882).

About 40 persons from different countries were listed in Barrois and Fol's report who worked as if at the Laboratory during three years (1882–1884). Among them were also mentioned several Russians — Kowalevsky, Metschnikoff, Wagner, Davidoff, and Korotneff (Barrois and Fol 1887).

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[1] Philipp Vassil'evich Ovsjannikow (1827–1906). Physiologist-zoologist, Prof. of Kazan and St. Petersburg universities, ordinary academician of the Imperial Academy of Sciences in St. Petersburg.

FIGURE 1. Russian Zoological Station at Villafranca. About 1892. From postcard. Archive of Observatoire Océanologique de Villefranche-sur-Mer (Russian Archive of the Villefranche Zoological Station—RAVZS). In the left part two small towers ("pavilions") of the former "lazaret", where Barrois's laboratory was located are visible.

FIGURE 2. Russian zoologists, who worked in Villefranche-sur-Mer before the Russian Zoological Station. 1- N.P. Wagner, 1890s; 2- A.O. Kowalevsky, 1880s; 3- V.N. Ulyanin, 1880s; 4- A.P. Bogdanov, 1890s; 5- Ph.V. Ovsjannikow, 1890s; 6 - W.W. Salensky, around 1910; 7- I.I. Metschnikoff, 1880s; 8- M.M. Davidoff, 1890; 9- A.A. Korotneff, 1890. 1–3, 5 –Archive of the St. Petersburg Naturalists Society; 8, 9—Archive of the Naples Zoological Station; 4, 6, 7—Archive of the author.

FIGURE 3. Boat of the Station, 1895. Photo by N.A. Ivantzoff. From the Station's report published in 1896 (University reports of the Imperial University of St. Vladimir, 6(II):1–19).

FIGURE 4. M.M. Davidoff and W.F. Karavaeff (?) in the Station laboratory, 1895. Photo by N.A. Ivantzoff. From the Station's report published in 1896 (University reports of the Imperial University of St. Vladimir, 6(II):1-19).

FIGURE 5. The large hall of the Station, 1909. Archive of RAVZS.

FIGURE 6. The entrance to the Station territory. 1900s. Archive of RAVZS.

FIGURE 7. "Velella"—motorboat of the Station. 1900s. Archive of RAVZS.

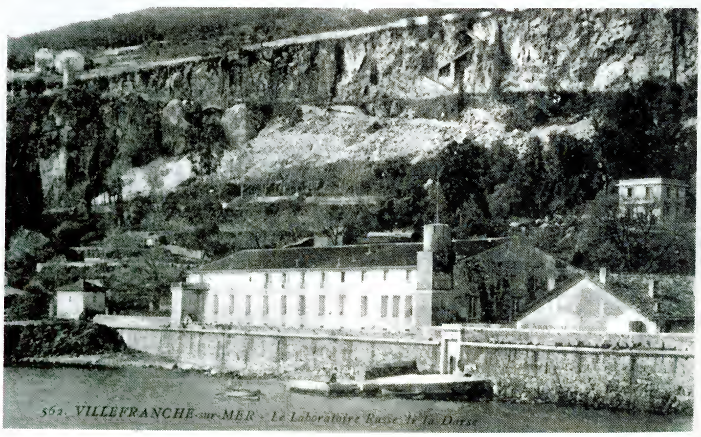

FIGURE 8. Russian Zoological Station at Villafranca. Postcard, 1900s. Archive of the author.

FIGURE 9. Staff persons of the Station. From the top, left: A. A. Korotneff, 1907, M.M. Davidoff, 1907, T.E. Timofeeff, 1910?, F.A. Spitschakoff, 1911. Archive of RAVZS.

FIGURE 10. The experimental zoology course in 1911. Among of the participants, from the left: F.A. Spitschakoff (second), M.M. Davidoff (sixth), T.E. Timofeeff (twelfth), G.P. Mittens (thirteenth), I.I. Sokoloff (fifteenth). Archive of RAVZS.

We are saying, "worked as if" because 23 persons listed for two years (at the beginning of 1884 the laboratory had already moved into the "Russian house") for a small and, apparently, not well-equipped institution, is very high number.[2] Certainly, it is a question — how the number was calculated is a puzzle. Did all of those people have tables in the Laboratory, or did some of them just use equipment or get some help there? Unfortunately, we cannot find yet any indication that all of the Russian persons really worked at the Laboratory. Only one paragraph from the letter of Kowalevsky could be treated in this way. Actually, he is always talking about a station, not a laboratory. In March 1882, he wrote to Metschnikoff:

> Dear Iliya Iliich, your letter a bit disappointed Barrois, who had hope for your help… I would think, by the way, that the Villafranca station could be a great benefit for young Russians. Every year some Russians, who are completely unknown for us, are visiting the place… For all of them the Naples Station is inaccessible — no Academy would recommend them — they are just beginners… For all of these people the station in Villafranca is a necessity… Accordingly, I still hope that you will endorse the general proposal, for example to the Academy, about help for the Villafranca zoological station. (Letters of A.O. Kowalevsky to I.I. Metschnikoff, p. 125)

In any case, we can indicate the variety of objects used at Villafranca by Russians at that time. The strategy of A.O. Kowalevsky, who made numerous and significant contributions to evolutionary and comparative embryology, for instance, would always be to investigate several objects simultaneously. The majority of his studies were connected with developmental processes of different invertebrates. It was not easy to predict which one would develop adequately. He used the same way of study everywhere: in Messina, Naples, El-Tor (Red Sea), and Marseille as well as Villafranca.

> I am working with salps and actinia, but it is quite boring… In the last days I have started to work with holothuria… I have found one *Doliolium* and the investigation of its tail gave the same result as for salps… Here many animals are suitable for the University course when I will present lectures about mussels; worms and crustaceans could be collected. So, I have decided to make a collection for the practical lessons… I am working with Pteropoda, but still have very small results… I have tried to investigate coral development… I already started to work with the *Chiton*, but the caviar of *Chiton viloaceus*, which I am reinvestigating now, is quite bad…(Letters of A.O. Kowalevsky to I.I. Metschnikoff, pp. 113–119)

These are just indications about Kowalevsky's objects during four months in 1879. Actually, Kowalevsky's main result during his time in Villafranca (1878–1882) was, afterwards, an excellent study about chiton development.

At Villafranca, M.M. Davidoff investigated the development of Physophorides and Diphyides (Cnidaria): *Hippopodius*, *Agalma*, *Phialidium,* as well as of *Cunina* and *Aglaura*. Korotneff did investigations on embryo formation of salps, development of ascidians, on some cell elements of Anchinie (Tunicata), and on the histological structure of Cnidaria: Diphyides, Apolemides and general structure of Physophorides and Siphonophores. N.P. Wagner worked in Villafranca on morphology of tunicates and *Cymbulia* (Gastropoda). And I.I. Metschnikoff did a number of studies on medusa development: *Laodicea cruciata, Octorchis gegenbauri, Phialidium viridicans, P. ferrugineum, Mitrocoma, Polyxenia leucostyla* and *Cunina lativentris*.

Another person who productively investigated marine fauna and wished to organise the zoological station in Villafranca was Carl Vogt. He was an excellent naturalist, of German origin, and

[2] In all of Russian biological stations at the beginning (the few first years of its existence) as well as at the Russian Station in Villafranca, not more than 4–8 persons worked at each station per year.

a professor of zoology in Geneva. Vogt successfully worked in Villafranca for a long time, mainly on Siphonophora and other pelagic invertebrates. Three times he tried to establish a station in different places of the Mediterranean coast, but he was not lucky in this respect and some external circumstances always derailed his efforts. He had quite a bad relationship with Barrois and, even more so, with Fol (who was his colleague at Geneva), and about whom Vogt once wrote to Korotneff: "Vous verrez, que notre diable d'ami est très à craindre" (Korotneff 1911). Relations between Vogt and Korotneff, on the contrary, were good and later the Swiss scientist was called by Korotneff "the godfather of the Russian station" (Korotneff 1911).

Organisation and development of the Russian Zoological Station in Villafranca in 1886–1931 (now [2007] the Observatoire Océanologique de Villefranche sur Mer, Université Pierre et Marie Curie, Paris, France)

Officially the Russian Zoological Station in Villafranca opened in 1886, though its organisation actually started in 1884. It was the only zoological station at the Mediterranean Sea to be founded by Russians and it functioned for almost 45 years under the aegis of Russian scientists (Kofoid 1910; Korotneff 1911; Koltzoff 1915; Novikoff 1935; Tregouboff 1983).[3] It was the brainchild of A.A. Korotneff, a professor at St. Vladimir University in Kiev, a prominent specialist in invertebrate zoology and embryology and a former student of Prof. Anatol (Anatoliy-Russ.) P. Bogdanov (1834–1896) at Moscow University.[4]

Alexis A. Korotneff was born in Moscow and graduated from the Moscow University as a zoologist (1876), then spent some years working for the state administrative service. After that he studied medicine at the same University, but, finally, returned to zoology and got a doctor of zoology degree in 1881. In 1886 he was appointed a professor in Kiev, and remained in this position until 1912. Korotneff was a tireless traveler. He spent a considerable part of his life on scientific trips and expeditions both in Russia and abroad, where the majority of his time was occupied by the Russian Zoological Station at Villafranca.

Korotneff worked in Villafranca several times before 1884, when the idea for a Russian station, generated earlier, was accepted and a place where it could be located was found. It was the building a hundred meters away from the "lazaret", where the laboratory of Barrois had been located in 1882–1883. This "Russian house" at first was totally unsuitable for scientific purposes. It was, in fact, an old spacious prison built in 1769. In 1857, the Sardinian government allowed Russia to use it for the needs of its fleet, which up to 1878 had a base in Villefranche (Koltzoff 1915). Then France did likewise. In fact, it was a kind of free-rent agreement, made until the building might be used. After the Russian fleet has been moved to Piraieus (Greece), the building was no longer needed and it housed a field hospital for some time.

After Korotneff's petition, the Russian Marine Ministry, thanks to the help of Mikhail Yu. Poggenpol (who became a personal friend of Korotneff), allowed him to accommodate a zoological station in the "Russian House" (1884), as it was called by the locals. The Russian government allocated some money for the project (1700 rubles per year just for keeping this building in shape), but most investments were made by Korotneff himself, who became both the director and the owner of the newly born station.[5] Funds for reconstruction and maintenance were raised from a

[3] The main official documents connected with the Station are deposited in the Russian Governmental Historical Archive in St. Petersburg (RGHA SPb), fund 733, inventory 142, file 792. A small part of the Russian archive that had been left in Observatoire Océanologique de Villefranche-sur-Mer (Russian Archive of the Villefranche Zoological Station — RAVZS) was classified by me during my visit to Vilefranche in 2004 into 17 files.

[4] A.P. Bogdanov was not only an excellent teacher, but also a very active and powerful public figure.

[5] RGHA SPb, fund 733, inventory 142, file 792.

variety of sources. Korotneff managed to get some allocations from different Russian ministries: the Marine Ministry, the Ministry of Finance and the Ministry of People's Education. The Kiev University paid the assistant's salary; a next-to-nothing sum was given for some time by the French government. From time to time various donations were received.

As mentioned above, Barrois and Fol were invited to use the same building when they were no longer able to use the "lazaret" for their laboratory. Soon after that, in the spring of 1885, Korotneff set out on an almost one-year-long expedition to the Dutch Indies, that had been commissioned by the St. Petersburg Naturalists' Society. Before leaving, he asked H. Fol and J. Barrois to take care of his station's management in his absence; that was not the best idea. Fol, who replaced the director, not only resumed the activities of own laboratory at the Station (1885–1887), but later even thought of selling the "Russian House" and using the proceeds to built a station elsewhere (Korotneff 1911).

Having returned from the tropics, Korotneff tried to take over the Station's directorship but encountered stiff resistance. Fol and Barrois simply ignored Korotneff's requests to get the Station back. The incident was resolved only after the interference of Baron Morenheim, the Russian Envoy in Paris. According to the French Foreign Office's instruction, Fol and Barrois had to move out of the "Russian house" in ten days; they then settled in Nice (Korotneff 1911). At that moment the report "Plan of reorganisation of the laboratory in Villefranche (Nice)" was made (Barrois and Fol 1887). They did not mention the reason for moving from Villafranca to Nice but just stressed: "…At present, after six years of successful existing, the laboratory could die because of the impossibility of getting one of the buildings that the government has around the Villefranche inner harbor!" After Fol's death on an expedition to the Bay of Biscay (1892), the French-Swiss laboratory ceased to exist.

In a report devoted to the 25th anniversary of the Station, Korotneff gratefully acknowledged the contribution of different people to the Station's support. Among them were His Imperial Highness Grand Duke (Prince) Mikhail Alexandrovich, the famous Swiss scientist Carl Vogt, and an official of the Russian Marine Ministry, Mikhail Yu. Poggenpol, Korotneff's personal friend (Korotneff 1911). In February 1897, Grand Duke Mikhail Alexandrovich (1878–1918) became the official patron of the Station and procured a state subsidy of 26,000 roubles for it. This money was used to construct large aquariums with flowing water, to install a steam engine, to purchase a yacht, and to restock the library. In the autumn of 1900, the State Council decided to allocate 7100 roubles annually for the Station's maintenance; in 1901, 2500 roubles were added.[6] To compare, in 1904, the rent of four working Tables in Naples cost the Russian treasury 3700 roubles.[7]

The purpose of the Station was initially twofold. On the one hand, it was well suited for the needs of independent students from natural science faculties. On the other hand, the diversity of local fauna and the Station's improving equipment provided a wide choice of research topics and possibilities for their implementation.

In 1907, practical zoological courses for students were initiated at the Station. This arrangement had never been realized at other Russian biological stations. Courses were held in March and April so that visiting students, under the supervision of the Station's staff, could familiarize themselves with the rich marine fauna. In 1908, M.M. Davidoff, Korotneff's assistant at the Station since 1895 (then deputy director and director), also started a course on experimental zoology.

Numerous students visited the Station. Usually the majority of visitors mentioned in the Station reports at the beginning of 20th century came from the educational establishments in France,

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[6] RGHA SPb, fund 565, inventory 8, file 29387.

[7] RGHA SPb, fund 1129, inventory 1, file 70, lists 12–14.

Germany, Switzerland, and Russia as well as some people from England, Belgium, Italy, and the USA (Davidoff and Garyaeff 1910).

In time, almost the whole building was adapted to the Station's needs. There were several well-lighted laboratories, rooms for visitors, aquaria, running fresh and seawater, gas for thermostats and lighting. A small garden featured palms, orange, and lemon trees, cactuses, banana trees, and a flowerbed.

The Station's museum of local fauna was intended not so much for the general public as for the scientific staff, facilitating identification of animals in current samples. The public was allowed to see the Station's aquariums for an entrance fee. The Station owned a yacht of 7 tons displacement, "*Velella*", built by the Esher-Wiss and Co. company in Zurich. A marine engineer K.P. Koklevsky participated in the draft development. The Station was proud of its extensive zoological library, based originally on V.N. Ulyanin's personal library, that had been purchased for the station by A.G. Kuznetzoff. In 1895, the library received 25 periodicals, in 1910, 83 (Davidoff 1896; Davidoff and Spitschakoff 1911).

Before the outbreak of World War I, the Station was likely to get a large new steamer for oceanographical studies. During 1910–1914, Korotneff made some negotiations about this point with the Marine Ministry of Russia as well as with the Ministry of Public Education, and he also had visited the Naples Zoological Station for consultations. Unfortunately, the war intervened and all plans had to be shelved.[8]

Korotneff wanted the Station to be under the jurisdiction of the Russian government. This idea was energetically supported by the Deputy Minister of Public Education W.T. Schewiakoff (1859-1930). In 1914, several days before the outbreak of the war, the Station passed under the jurisdiction of the Ministry. A "Statute of the Russian Zoological Station in Villefranche named after Prof. A.A. Korotneff" was legislatively confirmed. The Station's budget was fixed at 18,000 roubles a year,[9] which was a largest budget of any Russian station (Fokin et al. 2006).

Korotneff's assistants at the Station were A. Bolles-Lee (1888–1891) and E. Veber (1891–1895). From 1895, a well-known zoologist, M.M. Davidoff, who had previously worked in Heidelberg and Munich, shared the labor of the Station's management with Korotneff. According to Korotneff's wishes, Davidoff was appointed director after Korotneff's death (1915).[10] In the 1900s, V.P. Garyaeff, F.A. Spitschakoff, and T.E. Timofeeff also worked at the Station as assistants.

Mikhail M. Davidoff (1852–1933) was born in St. Petersburg, but from childhood he lived much of the time in Europe. In Paris and Leipzig he studied music (1860–1864). After some years of private training as a musician, Davidoff went to the Moscow Conservatory, from which on completion of his studies in 1872 he received a good medal. However, after becoming acquainted with Darwin's theory and with some investigations on the evolution theory, he gave up on a career in music and went first to Jena University and then to Heidelberg for biological education. In Heidelberg, Davidoff did his zoological investigations leading to a Ph.D. degree under the supervision of Prof. C. Gegenbaur and, partly, Prof. O. Bütschli. The latter invited the young scientist to be his assistant. In fact, Bütschli introduced his Russian colleague to Villefranche-sur-Mer, where together they collected some material for practical lessons in 1881. In 1884, Davidoff left Heidelberg for Munich, where he worked at the Institute of Embryology and Histology at the University. Although the main subjects for Davidoff's researches at that time were amphibians and fishes, he also pub-

[8] RAVZS, files 11; Sokoloff, I.I. 1999. The daily-notes of the expedition to Kenya and Uganda at 1914. St.Petersburg State University Press. 259 pp (In Russian).

[9] RGHA SPb, fund 1129, inventory 1, file 109, lists 48–60; fond 733, inventory 145, file 333; fund 1158, inventory 1, file 190; RAVZS, file 2.

[10] RAVZS, files 9, 10.

FIGURE 11 (above). Unusual prey. The Station staff and some students with a moon-fish. 1910. From the left: second T.E. Timofeeff, then F. A. Spitschakoff, K. Volpin, I.D. Strel'nikov, A. Sigliansky. Archive of the author.

FIGURE 12 (right). Recreational time for scientists in Villafranca. 1911. From the left: Zelenko, E.M. Davidoffa (third), then, T.E.Timofeeff, I.N. Filip'eff, V.M. Schütz, I.I. Sokoloff. Archive of the author.

FIGURE 13. Working staff and researchers of Villefranche Zoological Station. 1911. From the left (first row): Mangiapain (fishermen), Sholtz, Kritch, Müller, F.A. Spitschakoff, Shacillo, Loginov, Leinander, Krasinska; (second row): Kukol-Yasinopolsky, Pauly, ?, Belyankin, Rakovskiy; (third row, standing): Anigshtein, Zelezko, I.I. Sokoloff, A. Vassilev, T.E. Timofeeff, Nezabitovsky, W.W. Salensky, M.M. Davidoff, G.I. Mittens, W. Schkaff, S.E. Kuschakewitsch, Osorgin, ?, Onore. Archive of the author.

FIGURE 14. A.A. Korotneff and M.M. Davidoff are seating on the right side, P.P. Sushkin on the left, with some technicians and guests (standing, second and third from left to right), S.A. Zernov, W, Garyaeff. In the inner yard of the Station. Archive of RAVZS.

FIGURE 15. View of the Station's library with portrait of Korotneff. 1929. Archive of RAVZS.

FIGURE 16. G.S. Tregouboff and M.M. Davidoff in the Station's laboratory. 1925. Archive of RAVZS.

FIGURE 17. S.S. Tschachotin, 1905? (left in the upper row), from 1904 visited the Station many times, the last - in 1947. Archive of the author; I.D. Strel'nikov, 1935 (right in the upper row), worked at the Station in 1910. Archive of the author; K.N. Davydoff, 1927 (left in the lower row), worked at the Station in 1925. Archive of Observatoire Oceanogique de Banyuls; G.S. Tregouboff, 1920s (right in the lower row), worked permanently at the Station from 1916 to 1956. Archive of RAVZS.

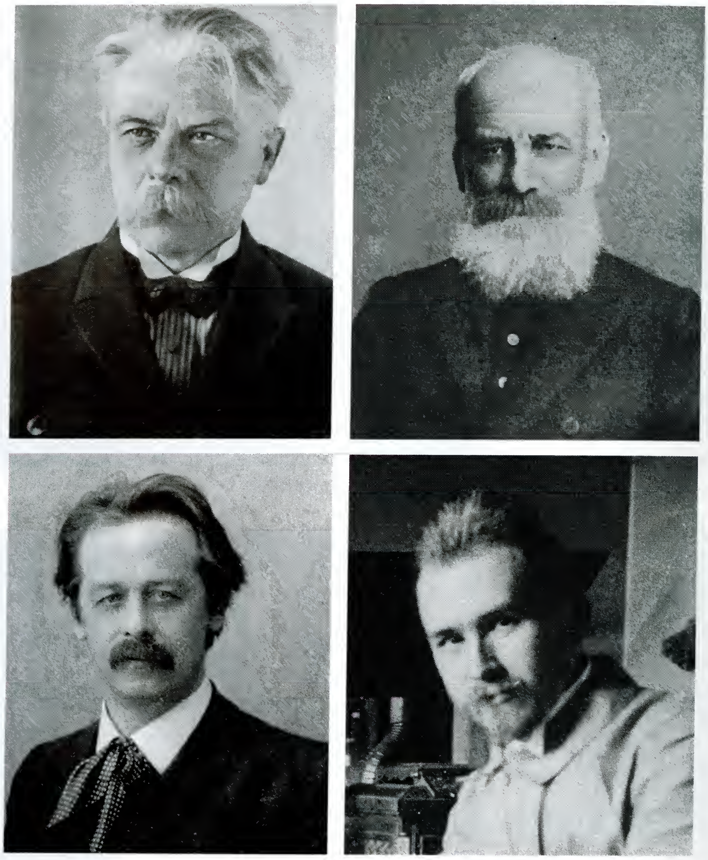

FIGURE 18. N.K. Koltzoff, 1925? (left in the upper row), the first time at the Station in 1898; N.A. Ivantzoff, 1925? (right in the upper row), the first time at the Station in 1895; S.I. Metalnikoff, 1907 (left in the lower row), the first time at the Station in 1895. Archive of the author; M.M. Novikoff, 1901 (right in the lower row), the first time at the Station in1903. From Fokin 2002 (*Microkosmos*, 93 (2): 91–98). All of the scientists worked at the Station many times and tried to keep it as the Russian station after 1917.

lished a textbook on histology. From 1886 to 1891, he worked five times at the Naples Zoological Station (and again in 1910). While in Naples he became friends with A. Korotneff, and this eventually led him back to Villafranca in 1895 (Fokin et al. 2006).

Under the joint leadership of Korotneff and Davidoff, the Russian Zoological Station at Villafranca became one of the most popular biological stations on the Mediterranean, not only because of good equipment and opportunities for studying a diverse pelagic fauna, but also because of the warm welcome biologists of all nationalities received there. As at the Naples Zoological Station, an international spirit reigned in Villafranca. However, the social structure of the visitors was distinguished by more democracy than at the Naples Zoological Station — one reason, the majority in Villafranca were students.

The long list of scientists who enjoyed the Station's hospitality includes people of many nationalities, though the majority of the visitors were Russian and German. In 1907–1908, the Villafranca Station was second only to the one in Naples in the number of researchers. In the Station's 25th anniversary report, a list of people who had worked there before January 1, 1911 was published, together with short notes about their research. There were among the Russian visitors not only students and magistrants but experienced zoologists: A.O. Kowalevsky, W.A. Wagner, W.W. Salensky, M.A. Menzbir, K.S. Mereschkowsky, V.N. L'voff, A.N. Severtzov, W.M. Schimkevitsch, D.D. Pedashenko, M.N. Rymsky-Korsakov, E.A. Bihner, N.A. Ivantzoff, N.V. Nasonov, A.K. Mordvilko, V.V. Redikortzev, P.P. Sushkin, B.V. Sukatscheff, A.A. Ostroumoff, B.A. Svartschevsky, J.N. Wagner, N.K. Koltzoff, N.A. Livanow, S.A. Zernow, M.M. Novikoff, S.S. Tschachotin, and others (Davidoff, Spitschakoff 1911). According to the entries in the Station's journal, 352 people had worked at the Station before 1911. In fact, the general number of visitors could be close to 400, as some people did not register in the Station's book.

Faunistic research predominated at the Station, followed by embryological, anatomical, histological, and cytological work. The main objects of study were, of course, marine animals, but terrestrial fauna and flora were also investigated. A few physiological studies were conducted and a special physiology department was envisaged, only to be thwarted by the onset of World War I. The zoological station was gradually changing into a general biological one. And, although some of the protists — ciliates, radiolarians, sporozoans, and microsporida, were studied, the Metazoa remained the main focus of the Station, including many different Coelenterata (Cnidaria) and representatives from other major groups, especially planktonic ones and those that have interesting planktonic stages including Ctenophora, Polychaeta, Nemertina, Gastropoda, Pteropoda, Echinodermata, Chaetognatha, and Tunicata. All were studied from various points of view.

The Station's laboratory sought to improve the methods of processing and preserving zoological material, experimenting widely with formaldehyde, a fixative solution recently introduced into zoological practice. Collections, both scientific and educational, and materials for practical classes were made at the Station. For example, the 1909 report mentions that collections were sent to 70 addresses; in 1910, 80 parcels were sent (Davidoff and Spitschakoff 1911). Sale of collections (mostly of pelagic animals) brought the station about 600 roubles a year.

The Russian Villafranca Station contributed to a new exhibit at the Russian Zoological Museum in St. Petersburg when it moved into a new building. The Station's collections were successfully presented at exhibitions such as the Exposition Maritime Internationale in 1907.

At the Station people, not only worked but, also, sometimes, made or participated in different celebrations and festivals. In 1911, all visitors and the staff were involved in a celebration of the 25th anniversary of the Station; a handmade poster for such a recreational event is still preserved in Villefranche. Usually students and some scientists took part in the local festival of Villefranche community — the feast of flowers.

One student, Ivan D. Strel'nikoff (1887–1981), later on a professor of biology in Leningrad (St. Petersburg), Russia, who worked at Villafranca in 1910 recollected about his time there as well as about one of such recreational events.

> I started to work with great enthusiasm: made a collection of marine organisms and studied its anatomy and embryology. Swimming by row boat in the bay, collecting animals, watching bright and colorful life in the water near by a coastline, working with microscope, drawing made preparations, wrote Strel'nikoff, all of that stuff has swallowed up my soul… At the same time Prof. N.K. Koltzoff, well-know Moscow scientist, worked at the Station; he studied in Villafranca the morphology of protists like *Zoothamnium* and other ciliates. Before his departure, Koltzoff, a wealthy man, decided to make a big picnic for all the Station's staff and visitors. In the palm garden of the Station, some tables with good French wine and various viands were prepared. Among of them was a typical Provence dish from different marine animals (bouillabaisse): octopuses, marine crabs, and caviar of sea urchins, different fishes and so on. People drank a lot, but in breaks also drank strong coffee. The feast, according to Russian tradition, was accompanied by talk about scientific and political topics of far off Russia and on philosophy. Active conversations interrupted by the singing of songs, which were heard far away from the Station, astonishing for the local people. As a result, some of participants got so tired that they fell down from exhaustion. At the end, my friend Sigriansky and I had to drag zoologists who had passed out from the feast to their sleeping places.[11]

Some of the scientists and students who worked at the Station were involved in illegal revolutionary activities. T.E. Timofeeff, a specialist on nemertines, was at the Station during the period 1907–1915, from 1908 as an assistant. While a Privatdocent at Kharkov University, he actively participated in the social-democratic working party's actions during the first Russian revolution (1905), and as its delegate he was arrested in September 1906. Because legal procedure ended in 1907 with Timofeeff's conviction, he escaped from Russia and went to Villafranca.[12]

Another scientist, the zoologist-physiologist and, then, biophysicist and political figure S.S. Tschachotin (1883–1973), who worked at the Station several times (at first as a student in 1904, 1905 and 1906), was involved in revolutionary activity right in Villafranca. Later he recollected this event in memoirs:

> In 1905 I was a student in Heidelberg University where I worked in the laboratory of famous Bütschli. There were several Russians at that time in the laboratory: Koltzoff, Sushkin, Zavarzin, Khohlov, Zavadsky, Novikoff — all of them future professors in Russian universities…Terroristic acts in Russia against the Tsar's officials, the "Iskra"— newspaper made by Lenin, hatred of autocracy: all of those things are being discussed and disturbing us… During spring vacation we went to Villafranca with A.M. Zavadsky. At the station were still a few visitors… We were working all day long; for the lunch we visited the small and cheap hotel "Hotel de l'Univers" where the station's visitors usually are accommodated. When we finished lunch, after a brief walk, we were again at the station. There is a good library: so many interesting books and articles about marine biology. At the station, in the wall of a large dark hall were mounted several aquariums where a lot of fantastic marine forms are swimming, creeping, and sitting on the bottom, walls and artificial rocks. Meantime twilight was coming; some lights switching on in the bay; nobody was at the Station anymore…From the depot we got bottles with nitrogen acid and glycerol — it arrived in my name as if for my experiments with animals and fixation. We care-

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[11] Archive of the author.

[12] RAVZS, file 14.

> fully take it out on the small moor, where a row boat awaited us, and swim with it to the opposite side of the bay. There is located a nice villa with a wooden pier. Here four Russians, fluent French speakers, were living as tourists. This was the group of socialist-revolutionaries who were producing explosives and then assembling bombs. In special suits they will be transported across the border to Russia for terrorist groups of the social-revolutionary party — "boevie druzini"[13]

Fortunately, the majority of Russians in Villafranca did only science. However, the Station became also attractive for Russian intellectuals from very different fields. The Station's scientists and, first of all, Korotneff himself were a centre for the cultural community in Villafranca and Nice, a favourite resort of Russians on the French Riviera in the early 20th Century. In the years before his death, A.A. Korotneff often lived in his own villa in the suburbs of Nice, not far from Villafranca, where he was visited by many prominent men of science and culture. One of the reasons was a good private collection of fine art established by Korotneff. He had some nice examples of paintings made by Tropinin, Repin, Aiwazovsky, Dubovskoy, Polenov, Shishkin and some other well-known or even famous Russian artists of the second part of the XIX c.[14] Thinking about the future of his brainchild, Korotneff left the Station more than 40,000 roubles in his will.[15]

At the beginning of World War I (summer 1914) the Station still was working: 21 scientists and 9 students visited Villafranca at that time; then activity was curtailed. Only deputy director M.M. Davidoff (appointed director in 1915), assistant G.P. Mittens, and a fisherman were left of the staff. At request of the commandant of the Villefranche fortress, the Station housed 60 alpine riflemen and a soldiers' boot-maker's shop.[16] By the summer season of 1915, life at the Station returned to normal, though the war drastically decreased the number of visitors: from the autumn of 1914 to the autumn of 1916 only five scientists came to Villefranche (Tregouboff 1983).

After the Bolshevic revolution in Russia, the Station found itself in a desperate economic situation. Russian scientist emigrants formed a special Committee for its support. At first, Academician N.I. Andrusow (1861–1924), a geologist and palaeontologist, and a member of the Russian academic group in Czechoslovakia, was its chairman. Following his death, the Committee was headed by Prof. M.M. Novikoff (1876–1965), professor at the University of Prague, who had been expelled from Russia in 1922 by the famous "Philosopher's steamship". Prof. S.I. Metalnikoff (1870–1946), who has been the head of a laboratory of the Pasteur Institute in Paris after emigrating from Russia in 1919, was also a member of the Committee (Tregouboff 1983; Fokin et al. 2004).[17] Both of them worked at the Station several times and played significant roles in the Russian scientific society abroad.

Mikhail M. Novikoff, a morphologist and public figure who had been born in Moscow, studied biology at Heidelberg University under Prof. O. Bütschli's supervision (1901–1904). He then worked at Moscow University. In 1911, he was awarded the highest Russian university scientific degree, the doctor of sciences (in zoology), and became a professor. Later he became the last freely elected Rector of the University. (1919–1920). Politically, he was a member of the Constitutional Democratic Party (kadet), and in this field he also had a good reputation. His diverse public services included ten years on the Moscow City Council; he was a member of the Russian parliament (State Duma) and vice-chairman of the Committee for National Enlightenment, where he concen-

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[13] Archive of the author.[14] RAVZS, file 11. Major part ot the collection was donated by Korotneff to the Fine Art Museum in Kiev.

[15] RAVZS, file 7.

[16] RAVZS, file 8.

[17] A secretary of the Committee—A. Vassilieff; E.P. Kowalevsky—public figure and S.I. Korotneffa, the widow of the Station's founder also were deeply involved in this business.

trated on problems of higher education. In emigration, Novikoff spent the majority of his time in Prague, but he also worked in Heidelberg, Berlin, and Munich before finally settling in United States (Novikoff 1952).

Sergei I. Metalnikoff, protozoologist, physiologist, and immunologist, a pupil of A.O. Kowalevsky, belonged to a noble family from Simbirsk Province. He was educated in St. Petersburg University (1896) and then worked in the Russian Academy of Sciences (until 1910) and in the Biological laboratory (1910–1917), which had been established by Prof. P.F. Lesshaft, as well as in the Higher Women's Courses (1907–1917). In both of the last institutions, Metalnikoff was a professor. Immediately after the revolution in 1917, Metalnikov left for the Crimea and in 1919 went to Paris. In Paris, Prof. E. Roux, director of the Pasteur Institute, invited him to be the head of a laboratory. During the French period of his life, Prof. Metalnikoff contributed to the development of psychoneuroimmunology. He investigated immunity in invertebrates, mainly insects, studied connections of immune and nervous systems, and elaborated biological methods for pest control. While in France, he took an active part in the affairs of Russian organizations: the Russian People's University in Paris, and the National Association, an academic group.

M.M. Davidoff and the Committee (namely, Novikoff and Metalnikoff, who were experienced about Soviet power) avoided contact with Soviet government, notably the Commissariat of Education of RSFSR (then USSR), which tried to establish such a connection in the 20s. First of all, this policy was adopted because the political relationship between Soviet Russia and France had not yet been established and the Station was under sequester. Secondly, the Committee did not trust the new Russian government and, at the same time, negotiations with the Czech Academy about financial support already had been started. In fact, at first the Committee scraped up some donations and received modest support from the French government. Then the Czech Academy of Sciences helped out by renting 12 working places at the Station for Czech scientists (Tregouboff 1983). The rent was sufficient for the Station's maintenance.

However, attempts to get a connection with the Station from Soviet Russia's side were repeated by a couple of scientists who had worked on occasion at Villafranca before the revolution and had some power in the Soviet Russian scientific society, namely, N.K.Koltzoff (1872–1940) and N.A. Ivantzoff (1863–1927). The first, a well-known biologist (cell-biologist, protistologist and geneticist), was a Corresponding Member of Russian Academy of Sciences from Moscow. He worked at first in the University (Cabinet of Comparative Anatomy), and then at the Higher Women's Courses and in the People's University named after Shanyavskiy. In 1916, Koltzoff founded the Institute of Experimental Biology, one of the first scientific research establishments in Russia. The second, Ivantzoff, a morphologist-histologist, teacher, and public figure, also graduated from Moscow University (1886) and, at first, worked mainly on comparative morphology of vertebrates, not only in Russia, but in Germany (Heidelberg, Bütschli's laboratory) as well. At the beginning of the 20th Century, he shifted to teaching at different gymnasiums (Odessa and Moscow). From 1916, Ivantzoff worked in the Ministry of Public Education of Russia and then at Tambov (1918) and Moscow universities (1921). Both of these scientists maintained good relationships with Korotneff and Davidoff, but neither could not convince the Committee of the Villafranca Zoological Station about possible benefits of a relationship with Soviet Russia.

Just a few years afterwards, the head of the Committee, M.M. Novikoff wrote: "A peculiar situation occurred. The Russian committee, i.e. miserable homeless emigrants, offered hospitality to the scientific world" (Novikoff 1935). The Committee also established connections with the Krakow and Belgrad academies, which came to rent working places at the Station. Negotiations with the Bulgarian academy were under way. The Committee also hoped to get some support from United States institutions. However, at the end of 1920s, G.S. Tregouboff, *de facto* substitute for

the Station's director M.M. Davidoff in the mid-1920s, began negotiations, without the knowledge of the Committee members, about passing the Station over to the French government.

Gregory (Gregoriy– Russ.) S. Tregouboff (1886–1969) appeared at the Station for the first time at the end of 1914; a year later, he was appointed librarian for the Station. Tregouboff had been born in Kiev, Russia in the family of a governmental Consult member; he attended and graduated from the University of Montpellier, France where he focused mainly on protistological research. Thus, according to the Russian laws, he could not be a permanent assistant at the Station because he lacked a Russian diploma. It appears that was Korotneff pushed for acceptance of this candidate by Gregory's powerful father, who sent a particular petition to the Russian Public Education Ministry. At the end of 1914 Korotneff wrote to M.M. Davidoff: "I do not know Tregouboff, but, I think, it could be possible to get him at the station temporarily on a salary of Schneider".[18] Almost at the same time he wrote another message to Villafranca: "Perhaps, at present you already have Tregouboff for the help. I think, he is solid young person, I hope, he will be for you if not the right, but the left hand".[19]

When, in 1924–1925, Davidoff developed health problems, Tregouboff, in fact, replaced him, but officially he could not attain the vice-director position until 1932, during Prof. O. Duboscq's directorship. Some characteristics of Tregouboff as a person can be found in the recollections of A.U. Davydoffa, the widow of well-know Russian zoologist-embryologist Konstantin N. Davydoff (1878–1960), a distant relative of M.M. Davidoff. K.N. Davidoff worked and lived with his family at the Station in 1925.

> At the very beginning of May, 1925 we went to Villefranche-sur-Mer where K.N. is working in the Laboratory and where we could get a room for living… Then M.M. Davidoff, a distant relative of K.N., listed as a director, but he was completely senile at that time. In fact, the director was Tregouboff, a quite unpleasant man: always drunk and very rude, especially with Russians. His wife also was a not so simpatica French woman, hostile toward Russians and, in particular, to us. Fortunately, at that time there were several more scientists, thanks to that circumstance, we felt much better ourselves… On the other hand, we had very friendly connections with young scientists from Poland as well as with the son of Prof. Novikoff, Vladimir, who worked as a mechanic of the laboratory's motorboat... When "head" went to Paris, the laboratory was changed from the first day: whistle, laughter and bustle were in the corridor; many kinds of jokes were performed. Either Russian diner was prepared in some laboratory, or a common tea in the library, by sharing expenses.[20]

Thus, from the middle of the 1920s Tregouboff became a real host at the Station. He was quite sceptical about efforts of the Station's Committee to keep the Station as Russian institution without connection with Soviet Russia. In reply to the Committee's protests on his policy, he indicated that attempts to preserve the Station for Russia reflected nothing but a sentimental viewpoint and that its transfer to the French was the only way of ensuring its stable existence (Tregouboff 1983). In 1931, not only did the Villefranche station pass over to Paris University, but even the request to retain the name of its founder, Prof. Korotneff, in its name was not complied with (Novikoff 1935, 1952; Kowalevsky 2001). Unfortunately, extensive correspondence sent by Committee members to Tregouboff and Davidoff at this time (over 60 letters from 1925 to 1931) curiously disappeared from the Station, as did all of Tregouboff's personal archives. The finding of these documents, per-

[18] G.A. Schneider, one of assistants at the Station till 1915.

[19] RAVZS, file 6

[20] St.Petersburg's branch of the Archive of Russian Academy of Sciences. Fund 918, inventory 1, file 38, lists 24–27.

haps, would throw some additional light on the final years of the Russian Zoological Station at Villafranca.

One cannot exaggerate the importance of the Russian Zoological Station at Villafranca at the end of the 19th and beginning of the 20th centuries for the development of Russian natural sciences. Founded by first-rate zoologists with support of the Russian scientific community and the government, it supported the large contribution of Russian scientists to many branches of marine biology. It is equally important that, in the Russian Station, from a certain moment, opportunity was provided for marine experience for students, thus contributing to the training of experts in different branches of marine biology. Working in a friendly company of like-minded men, communication with both senior and foreign colleagues in a relaxed atmosphere close to nature brought to life a certain cultural phenomenon. Many people who had worked at the Station did their best to go there again. Unfortunately, after 1917, Russians could no longer experience this wonderful tradition.

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I am grateful to Prof. M. Glass, Dr. J.-C. Braconnot and Ms. M. Fioroni (Observatoire Oceanologique, Villefranche-sur-Mer, France) for possibility to work at Villefranche for some days with the archive of the Russian Zoological Station and getting a number of documents and photos copies. Especially I am very grateful to Ms. M. Fioroni for her kind help with the library investigation. I am appreciative to Ms M.-T. Panouse (Bibliothèque Observatoire Océanologique de Banyuls) for useful information and copies of some documents and photos from the library archive. I would like to thank Prof. N.I. Strel'nikova (St. Petersburg, Russia) and Mr. E.S. Tschachotin, St. Remy, France) for giving me some materials from the family archives. I am appreciative of Ms. T.V. Decoppet-Schütz (Bern, Switzerland) and Ms. O.I. Sokoloffa (St.Petersburg, Russia) for their gifts of some photos and useful conversations about the past of the Russian Zoological Station at Villafranca.

Literature

Barrois, J. 1882. Lettre de Barrois à Darwin lui demandant son soutien. In: La darse de Villefranche-sur-Mer: archiolpgie, navale, charpente <*http://www.darse.org/v1/sciences/darwin_barrois.html*> 20 October 2006. WEB CITATION.

Barrois, J., and H. Fol. 1887. *Memoire sur un plan de reorganisation du laboratoire de Villefranche (Nice).* In: La darse de Villefranche-sur-Mer: archiolpgie, navale, charpente <*http://www.darse.org/v1/sciences/fol_barrois.html*> 20 October 2006.WEB CITATION.

Blyakher, L.Ya.1955. *History of embryology in Russia.* In Russian. (БЛЯХЕР Л.Я. *История эмбриологии в России*, Москва, издательство АН СССР. 376 сс.)

Bracannot, J.-C., I. Palazzoli, and M. Servera-Boutefoy. 2004. *Villefranche sur Volga. Les Russes sur la Côte d'Azur à partir de 1850 et la naissance d'un institut scientifique. Вильфранш на Волге. Появление россиян на Лазурном берегу в 1850 году и рождение научного института.* (in French and Russian). Serre Editeur, Nice, France. 40pp.

Caullery, M. 1950. Les Stations Francaises de Biologie Marine. *Notes and Records of the Royal Society of London* 8(1):95–115.

Davidoff, M.M. 1896. Report on the Villafranca Zoological Station activity during 1895. In Russian. (ДАВЫДОВ М.М. Отчет о деятельности Вилла-Франкской зоологической станции за 1895 г., *Университетские известия Киевского университета св. Владимира* 6(II):1–19).

Davidoff, M., and A. Korotneff. 1897. Report on the Villafranca Zoological Station activity during 1896. In Russian. (ДАВЫДОВ М. и КОРОТНЕВ А. Отчет о деятельности Вилла-Франкской

зоологической станции за 1896 год, *Университетские известия Киевского университета св. Владимира* 7(II):1–31).

DAVIDOFF, M., AND N. KOLTZOFF. 1899. Report on the Villafranca Zoological Station activity during 1897-1898. In Russian. (ДАВЫДОВ М. и КОЛЬЦОВ Н. Отчет о деятельности Вилла-Франкской зоологической станции за 1897–1898 гг., *Университетские известия Киевского университета св. Владимир,* 6(II):1–42).

DAVIDOFF, M., AND W. GARYAEFF. 1906. Report on the Villafranca Zoological Station activity during 1903–1904. In Russian. (ДАВЫДОВ М. и ГАРЯЕВ В. Отчет о деятельности Вилла-Франкской зоологической станции за 1903–1904 гг. *Университетские известия Киевского университета св. Владимира* 3(II):1–74).

DAVIDOFF, M., AND W. GARYAEFF. 1907. Report on the Villafranca Zoological Station activity during 1905–1906. In Russian. (ДАВЫДОВ М. и ГАРЯЕВ В. Отчет о деятельности Вилла-Франкской зоологической станции за 1905–1906 гг. *Университетские известия Киевского университета св. Владимира* 12(II):1–84).

DAVIDOFF, M., AND W. GARYAEFF. 1910. Report on the Villafranca Zoological Station activity during 1907–1908. In Russian. (ДАВЫДОВ М. и ГАРЯЕВ В. Отчет о деятельности Вилла-Франкской зоологической станции за 1907–1908 гг. *Университетские известия Киевского университета св. Владимира* 2(II):1–84).

DAVIDOFF, M., AND PH. SPITSCHAKOFF. 1911. Report (jubilee) on the Villafranca Zoological Station activity during 1909–1910. In Russian. (ДАВЫДОВ М. и СПИЧАКОВ Ф. *Отчет (юбилейный) о деятельности Вилла-Франкской зоологической станции за 1909–1910 гг.*, Киев, типография Императорского университета св. Владимира. 114 сс).

DOGIEL, V.A. 1945. *A. O. Kowalevsky*. In Russian. (ДОГЕЛЬ В.А. *А. О. Ковалевский,* Москва-Ленинград, издательство АН СССР. 146 сс.).

EXPOSITION MARITIME INTERNATIONALE DE BORDEAUX. 1907. *Cataloge de la Section Scientifique.* Bordeaux, France. 21pp.

FANTINI, B. 2002. *The history of the Stazione Zoologica Anton Dohrn. An Outline.* Art Grafiche Solimene Casoria, Napoli, Italy. 84 pp.

FOKIN, S.I. 2006. *Russian scientists at Naples.* In Russian. (ФОКИН С.И. *Русские ученые в Неаполе.* С.-Петербург, Алетейя. 378 сс).

FOKIN, S.I., M.V. SLEPKOVA, A.V. SMIRNOV, AND J.A. LAJUS. 2006. *Russian marine biological stations late in the XIX-beginning of XX c.* In Russian. (ФОКИН С.И., СЛЕПКОВА Н.В., СМИРНОВ А.В. и ЛАЙУС Ю.А. *Русские морские биологические станции в конце XIX—начале XX вв.* Страницы 59–114 *в Фокин С. И. Русские ученые в Неаполе.* С.-Петербург, Алетейя. 378 сс.).

FOKIN, S.I., A.V. SMIRNOV, AND J.A. LAJUS. 2007. *Marine Biological Stations at the Russian North (1881–1938).* In Russian. (ФОКИН С.И., СМИРНОВ А.В. и ЛАЙУС Ю.А. *Морские биологические станции на Севере России (1881–1938).* Москва, издательство КМК научная книга. 126 сс).

FOKIN, S.I., M.N. TELEPOVA, AND P.A. SHEVARDA. 2004. Professor S.I. Metalnikoff and his Parisian archive. In Russian. (ФОКИН С.И., ТЕЛЕПОВА М.Н. и ШЕВАРДА П.А. Профессор С.И. Метальников и его парижский архив. *Вопросы истории естествазнания и техники* 3:110–123).

GHISELIN, M.T. 2002. Russian scientists at the Naples Zoological Station. Pages 94–100 *in* E.I. Kolchinsky, ed., *Between Science and Ideology.* Russian Academy of Sciences, Saint Petersburg Branch of the Institute for the History of Natural Sciences and Technology, Saint Petersburg, Russia.

HEUSS, T. 2000. *Anton Dohrn. A Life for Science,* 3rd ed. Springer-Verlag, Berlin etc., Germany. 245 pp.

KOFOID, C.A. 1910. The biological stations of Europe. *United States Bureau Education Bulletin* 440. 359 pp.

KOLTZOFF, N.K. 1915. A.A. Korotneff and the Russian Zoological Station at Villafranca. In Russian. (КОЛЬЦОВ Н.К. А. А. Коротнев и русская зоологическая станция в Вилла-Франке, *Природа* 11: 1411–1426).

KOROTNEFF, A.A. 1911. Preface for the report (jubilee) on the Villafranca Zoological Station activity during 1909–1910. In Russian. (КОРОТНЕВ А.А. Предисловие к юбилейному отчету. Страницы 1–6 *в Коротнев А.А. ред., Отчет (юбилейный) о деятельности Вилла-Франкской зоологической станции*

за 1909—1910 гг., Киев, типография Императорского университета св. Владимира).

Korotneff, A., and M. Davidoff. 1901. Report on the Villafranca Zoological Station activity during 1899–1900. In Russian. (КОРОТНЕВ А. и ДАВЫДОВ М. Отчет о деятельности Вилла-Франкской зоологической станции за 1899–1900 гг. *Университетские известия Киевского университета св. Владимира* 4 (II):1–48).

Korotneff, A., and M. Davidoff. 1904. Report on the Villafranca Zoological Station activity during 1901–1902. In Russina. (КОРОТНЕВ А. и ДАВЫДОВ М. Отчет о деятельности Вилла-Франкской зоологической станции за 1901–1902 гг. *Университетские известия Киевского университета св. Владимира* 1(II):1–60).

Kowalevsky, P.E. 2001. Daily-notes 1918–1922. In Russian. (КОВАЛЕВСКИЙ П.Е. *Дневники 1918–1922.* С.-Петербург, Европейский дом. 411pp).

Letters of A.O. Kowalevsky to I.I. Metschnikoff. 1955. (Письма А.О. Ковалевского к И.И. Мечникову. Ю. И. Полянский (ред.). Москва-Ленинград, издательство АН СССР. 284 pp).

Mazurmovitch, B.N. 1958. Life and Activity of Professor of the Kiev University A.A. Korotnev. (1854–1915). In Russian. (МАЗУРМОВИЧ Б.Н. О жизни и деятельности профессора киевского университета А.А. Коротнева. *Труды Института истории естествознания и техники* 24(5): 196–211).

Müller, I. 1975. One hundred years of the Zoological Satation in the service of international research. Pages 11–21 *in* C. Groeben, ed., *The Naples Zoological Station at the time of Anton Dohrn.* Emilio di Mauro Press, Napoli, Italy.

Novikoff, M.M. 1935. Russian scientific organization and work of Russian naturalists abroad: an introduction for Russian-emigrant scientific bibliography. In Russian. (НОВИКОВ М.М. *Русская научная организация и работа русских естествоиспытателей за границей: Опыт введения в русско-эмигрантскую научную библиографию.* Прага, Русский свободный университет. 142 pp).

Novikoff, M.M. 1952. *From Moscow to New York. My Life in Science and Politics.* In Russian. (НОВИКОВ М.М. *От Москвы до Нью-Йорка. Моя жизнь в науке и политике.* Нью-Йорк: Издательство им. Чехова. 376 pp).

Poljansky, Yu.I. 1955. (ПОЛЯНСКИЙ Ю.И. Письма Александра Онуфриевича Ковалевского к Илье Ильичу Мечникову. Страницы 5–36 *в* Ю. И. Полянский ред. *Письма А. О. Ковалевского к И. И. Мечникову.* Москва-Ленинград, издательство АН СССР).

Schmalhausen, I.I. 1937. Anton Dohrn and his role in development of the evolutionary morphology. In Russian. (ШМАЛЬГАУЗЕН И.И. Антон Дорн и его роль в развитии эволюционной морфологиию Страницы 9–22 *в* И. И. Шмальгаузен, ред. *А. Дорн. Принцип смены функций.* Москва –Ленинград, Огиз, Биомедгиз. С. 9–22).

Tregouboff, G. 1983. Histoire de la station zoologique de Villefranche-sur-Mer, *Bullitin de la Section des Sciences. Histoire des sciences* 4:23–131.

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Marine Biology in the Adriatic Sea: An Historical Review

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"*Aristotele, Ovidio, Giovenale, Plinio e Marziale parlano, benché di paesaggio, in lode a qualche adriatico prodotto, specialmente commestibile...*" (Aristotle, Ovid, Juvenal, Pliny and Martial all speak not so much of environments, as in praise of the products of the Adriatic, especially edible ones..."). It is with these words that Giandomenico Nardo presents his "*Bibliografia cronologica della fauna del Mare adriatico*" (Chronological bibliography of the fauna of the Adriatic Sea, Nardo, 1877), listing in chronological order, from the 16th century to 1875, with concise descriptions of the contents, all the works having as their subject the Adriatic Sea and its lagoons. He reviews works of the 16th, 17th and 18th centuries in which are described species of fish, molluscs, crustaceans and "sea stones" in the Adriatic. Some of the authors he cites are little known; others belong to the more famous ranks of scholars of natural history of those centuries: Bonanni, Vallisneri, Zanichelli, Marsili, Janus Plancus, Vianelli, Grisellini, Vandelli, etc. Among the works of the early 18th century, there are those by Antonio Vallisneri *senior* (1661–1730) (Fig. 1) on the discovery of ovaries in a mature eel from the Lagoon of Comacchio (Vallisneri 1715), and Gian Girolamo Zanichelli (1662–1729), who reported the presence of a "sea calf" (monk seal) off Rovinj in 1720 (Zanichelli 1720). It was as early as 1725 that the Bolognese Luigi Ferdinando Marsili, founder of the Accademia delle Scienze di Bologna, published his "*Histoire physique de la mer*" (Marsili 1725), a work that was unanimously recognized as the foundation of all later oceanographic studies (Fig. 2).

FIGURE 1. Antonio Vallisneri *senior* (1661–1730), the plate with the description of the ovary of an eel (from "*Opere Fisico-Mediche stampate e manoscritte del Kavalier Antonio Vallisneri raccolte da Antonio suo figliuolo*" Venezia, 1733).

There is, however, one volume, "*Della storia naturale marina dell'Adriatico*" (The natural history of the Adriatic Sea) by Vitaliano Donati (1750), that must be considered a milestone in the

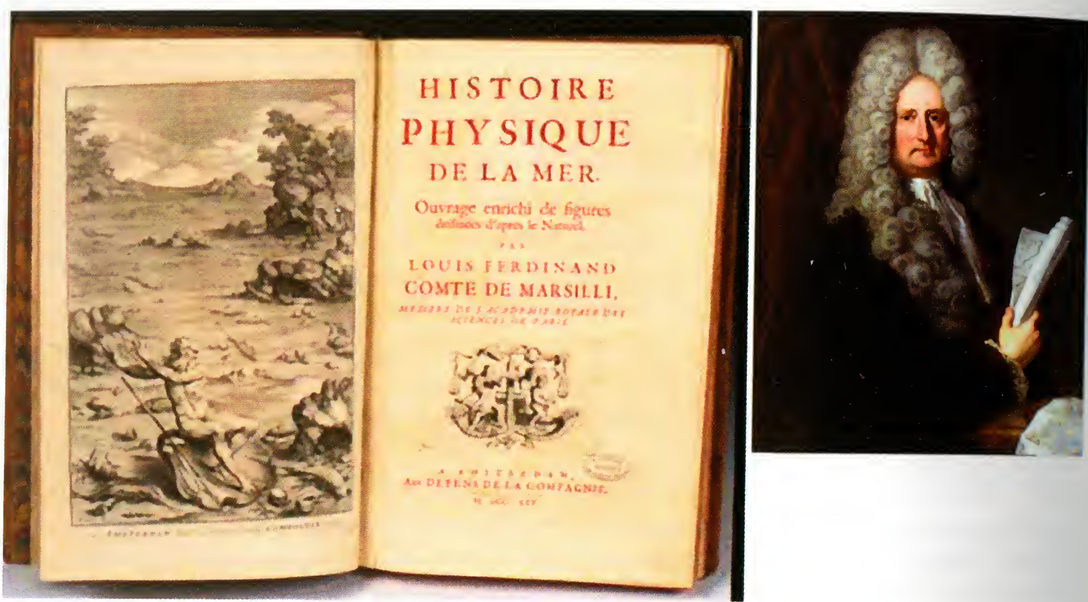


FIGURE 2. Luigi Ferdinando Marsili (1658–1730) the founder of the "Istituto delle Scienze" at Bologna. He wrote the first treatise on oceanography.

sector (Fig. 3). Donati, from Padova, took his degree in Philosophy and Medicine at the *Università degli Artisti*, as it was then called. Two of his teachers were Giovanni Poleni (1683–1761), a physicist and engineer, founder of "Experimental Philosophy" at the University of Padova, and Antonio Vallisneri *junior* (1708–1777), the only son of his famous father (Antonio Vallisneri *senior*), to whom the official histories have not devoted much attention. Relegated to the status of a background figure, Vallisneri Jr. is mainly remembered for having donated his father's collections to the University of Padova, for editing his father's posthumous works ("*Opere Fisico-Mediche stampate e manoscritte del Kavalier Antonio Vallisneri raccolte da Antonio suo figliuolo*" Venezia, 1733), and for himself being the first professor of Natural History, from 1734 to 1777.

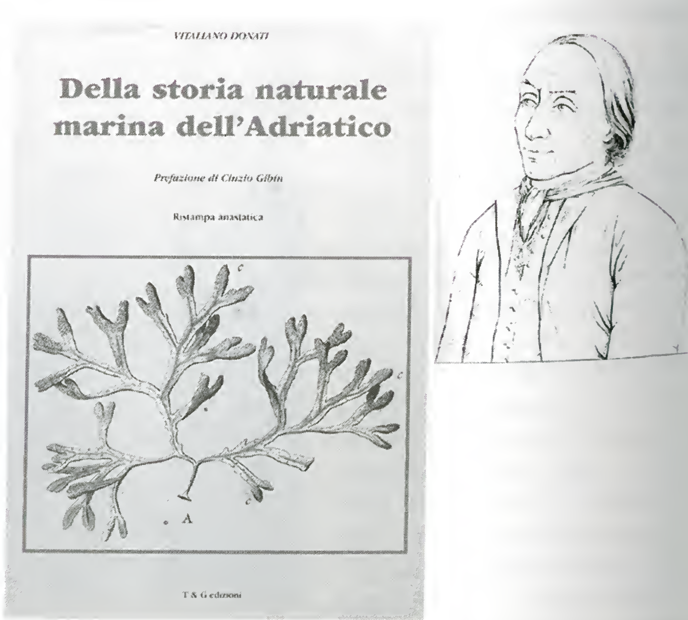


FIGURE 3. Vitaliano Donati (1717–1762). A recent (1999) anastatically reproduced copy of his work: "*Della storia naturale marina dell'Adriatico*".

In 1742, Donati accompanied Poleni to Rome, where the latter had been asked to restore the dome of St. Peter's. A meeting with the ecclesiastical physician Antonio Leprotti revealed the pos-

sibility of a natural history campaign in the Kingdom of the Two Sicilies. The plan was to collect fauna, flora and "petrifacts" in the area, in order to set up a natural history museum to be annexed to the chair of Natural History that Pope Benedetto XIV intended to institute at the University of Rome, a position to which Donati aspired (he was not granted it, but did obtain another at Turin, in 1750). However, Donati did not carry out the campaign, as an outbreak of the plague at Messina caused him to cancel all his plans. His research, therefore, moved to the area then called Illyria, between Dalmatia and Albania, in the eastern Adriatic, and his survey may be considered the very first natural history oceanographic campaign. The survey came to an end in 1745 and Donati prepared a report on it in the form of an essay (with 10 plates of drawings, dedicated to Leprotti), which was published in Venice in 1750. In this essay, which was extremely popular in Europe (one translation in French was published eight years later in Holland), Donati first provided a physico-geological picture of the bottom of the Adriatic Sea, within the framework of those studies, begun by Ferdinando Marsili, that maintained that the structure of the sea bed was like that of the surface of the earth. In the scientific ambit, Donati's work, which stimulated much more research in later years, covered many different subjects: he did in fact discover and describe in great detail new natural marine objects such as the "Virsoid" (*Fucus*) or "Cesalpino" (*Acetabularia),* algae that were abundant in several places in the Adriatic (Fig. 4). At the same time, his deep study and morpho-functional discussions led him to show the validity of some hypotheses which had given rise to lively debate among 18th-century scholars. Examples are the "animality" of coral and sponges. Observing polyps meticulously under the microscope, Donati revealed the similarities between these organisms, until then believed to be flowers or minerals, with other, already known, marine animals. He not only made great contributions to our knowledge of the rich marine heritage, but also anticipated results later confirmed by other scholars. At the same time, he represented nature according to the image of a "network" — an undoubtedly original idea with respect to that of the early 18th century, based as it was on the concept of a simple "chain of beings".

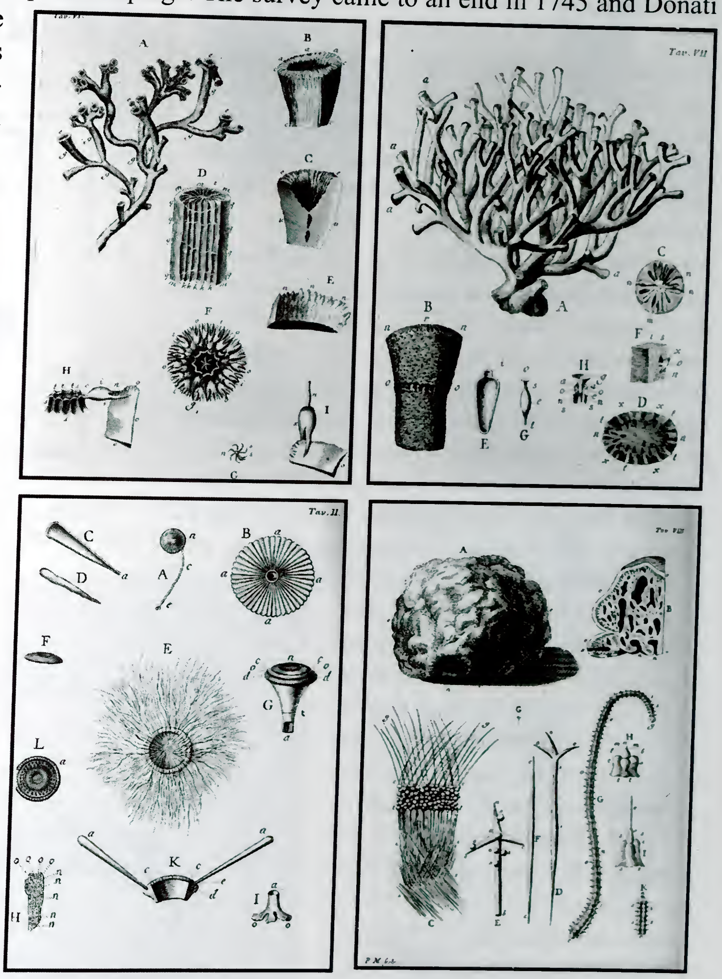


FIGURE 4. Some drawings of V. Donati from "*Della storia naturale marina dell'Adriatico*".

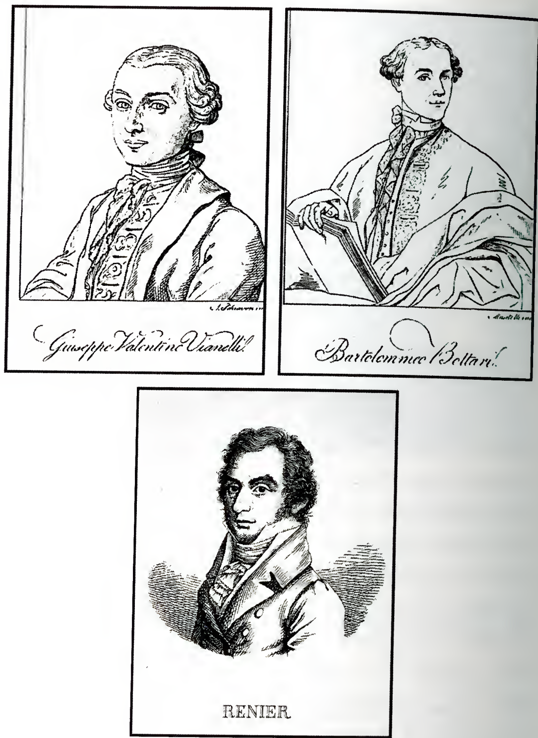


FIGURE 5. Some scholars of the "Chioggia group of marine naturalists of '700–'800".

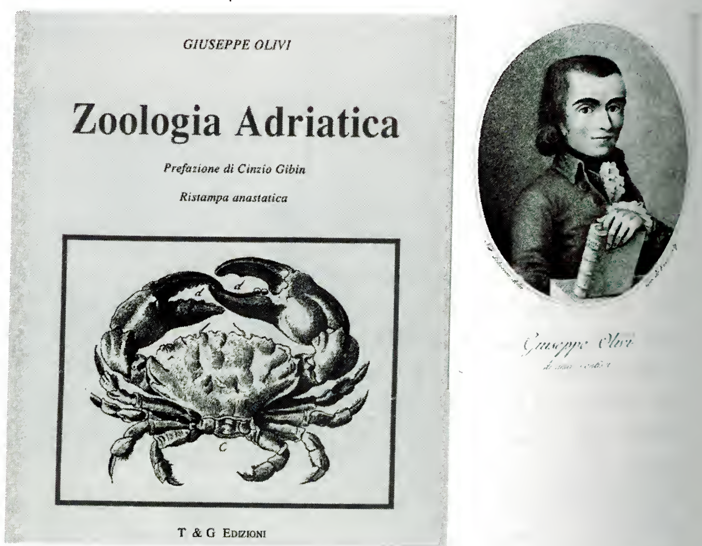
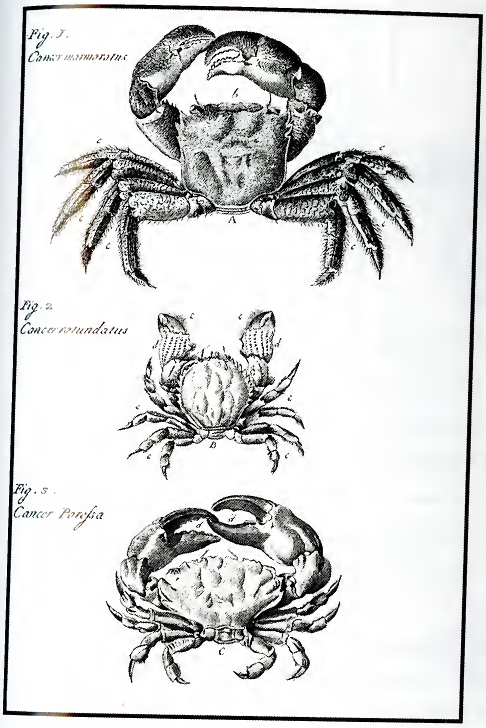


FIGURE 6. Giuseppe Olivi (1769–1795) and the anastatically reproduced (1995) copy of his work: "*Zoologia Adriatica*".

During the last 25 years of the 18th century and up to about 1850, a true centre for scholars of Natural Sciences, devoted in particular to marine biology, developed at Chioggia. The entire Chioggia school, from its founder, Giuseppe Valentino Vianelli (1720–1805), to Giuseppe Olivi (1769–1795), from Stefano Chiereghin (1745–1820) to Giandomenico Nardo (1802–1877), assistant to Stefano Andrea Renier (1759–1830), professor of Natural History at Padova (Fig. 5) and discoverer, in 1793 (Renier 1793), of a new type of *Botryllus* (which Lamarck had called *Polycyclus renieri* in his honour), and Fortunato Luigi Naccari (1793–1860), who as early as 1837 attempted, unsuccessfully, to found a Museum of Natural Sciences at the Episcopal Seminary at Chioggia (Nardo 1867). Giuseppe Olivi is the best-known of these. His most important publication, "*Zoologia Adriatica*" (Fig. 6), appeared in 1792. This volume was composed in epistolary form, following the custom of the time, addressed to Alberto Fortis (1741–1803), another Paduan, an ecclesiastic by career but a naturalist by vocation, devoted to studies on marine zoology, in the tradition of Donati. Olivi's work was published at the end of the century (Fig.7) and is certainly the most important result of that movement of exploration of all the lagoonal and marine waters that developed in the second half of the 18th century, notably in the Veneto. Olivi provided the first example of the application of mathematical criteria to the study of the shape of living forms (Fig. 8), at the same time indicating a quantitative type of approach to marine zoology. He also discussed the importance of defining study areas properly, and remarked on the need to relate living beings to the characteristics of the environment in which they lived and to understand the relationships between organisms of the same species and of different species. He anticipated ecological and zoogeographic concepts,



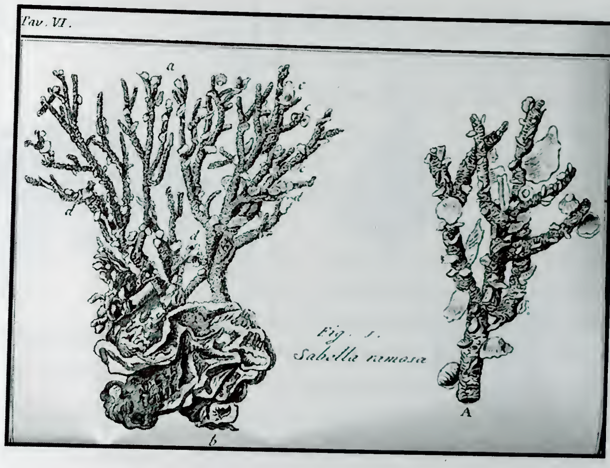


FIGURE 7. Some drawings of G. Olivi from "*Zoologia Adriatica*".

which were to receive precise definitions only in the following century.

Historical reviews become even more interesting when unpublished material comes to light. One recent praiseworthy restitution to the scientific community was the printing of a precious manuscript, now conserved in the Biblioteca Marciana of Venice: "*Descrizione dè Pesci, dè Crostacei e dè Testacei che abitano le lagune e il Golfo Veneto*" ("A Description of the Fishes, Crustaceans and Molluscs Inhabiting the Lagoons and the Gulf of Venice"), which represents almost a whole lifetime's work of the naturalist Stefano Chiereghin (1745–1820) (Fig. 9), a fervent scholar of marine biology, in the same Venice-Chioggia environment. The volume gathers together material resulting from 40 years of work in the Lagoon of Venice and its Gulf, from 1778 to 1818: precise drawings and detailed descriptions of 744 species of crustaceans, molluscs, echino-

FIGURE 8. Examples of application of mathematical criteria to the study of the shape of the marine organisms, from "*Zoologia Adriatica*".

derms and fishes, of which 455 are described for the first time, collected in 12 manuscript volumes.

When Chiereghin was still alive, some attempts at publishing his "paper museum" were made, including those of a famous French academic, Louis Augustin-Guillaume-Bosc. Chiereghin was asked to prepare his collection and present it as well as he could, because it was then to be housed in the prestigious Museum of Natural History in Paris, and his most beautiful drawings (Fig. 10) were to be reproduced by capable French engravers and their publication edited by the Augustin academician. Nothing came of this grand scheme; the collection and the drawings remained at Chioggia. The *Imperial Regio Governo* purchased the work and the collection in 1819 and took it to the *Liceo-Convitto* of St. Catherine in Venice where it was displayed to the public. The author had planned on publishing it later, but he died in 1820 before he was able to do so. Shortly afterwards, the drawings passed to the Biblioteca Marciana (the collection was dispersed), although it remained the property of the School of St. Catherine. Twenty years later, thanks to the intervention of Francesco Zantedeschi (1797–1873), professor of Physics in the *Liceo* (he was later to become professor of Physics at the University of Padova), the task of publishing an inventory of the species described by Chiereghin was given to Giandomenico Nardo, for the 9th Congress of Italian Scientists, held in Venice itself. On that occasion, Nardo inserted an updated list of the taxonomic nomenclature of most of the species.

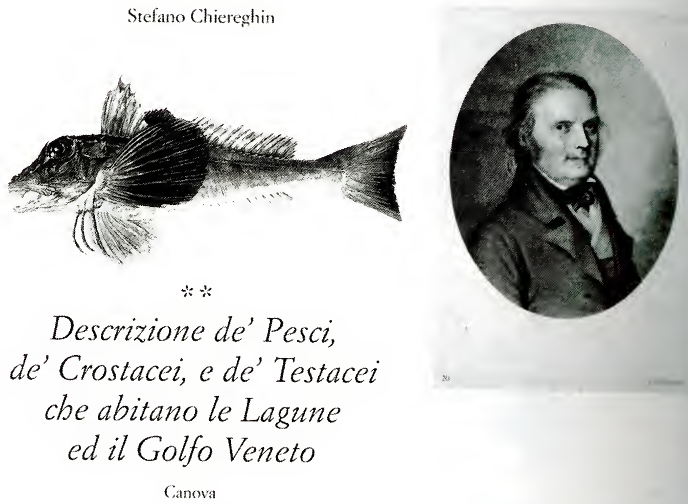


FIGURE 9. Stefano Chiereghin (1745–1820) and the cover of the recent publication of his large manuscript: "*Descrizione dè Pesci, dè Crostacei e dè Testacei che abitano le lagune e il Golfo Veneto*".

Since that far-off year of 1847, too much time has passed, and too few people later remembered the enormous amount of work that Chiereghin had accomplished. Today, the work provides us with an irreplaceable "data-bank" with which to reconstruct the lagoonal and marine fauna of the 18th century. It is an immense pleasure to read the meticulous descriptions of the morphology and reproductive and alimentary habits of so many species, perfectly located in their various habitats. The classification is that of Linnaeus, although for many animals it is flanked by Nardo's revised version (in the plates).

Lazzaro Spallanzani (1729–1799) also spent various periods of time at Chioggia between 1782 and 1795, 1784 was the most important year for his researches in the Lagoon of Venice and the northern Adriatic. Spallanzani was often accompanied by Chiereghin, who prepared drawings for him, to illustrate the ponderous *opus* that Spallanzani intended to publish on the natural history of the sea. These drawings, now conserved in the municipal library of Reggio Emilia, have recently been published in a volume edited by Gibin (1997). At Chioggia, Spallanzani studied how sponges feed, establishing once and for all the "animality" of these organisms that had several times been stated but never until then demonstrated. It should be recalled that, throughout the 18th century, scholars continued to speak of "zoophytes" and "plantanimals". In the company of specialists on marine flora and fauna who used to meet at the house of the doctor Bartolomeo Bottari

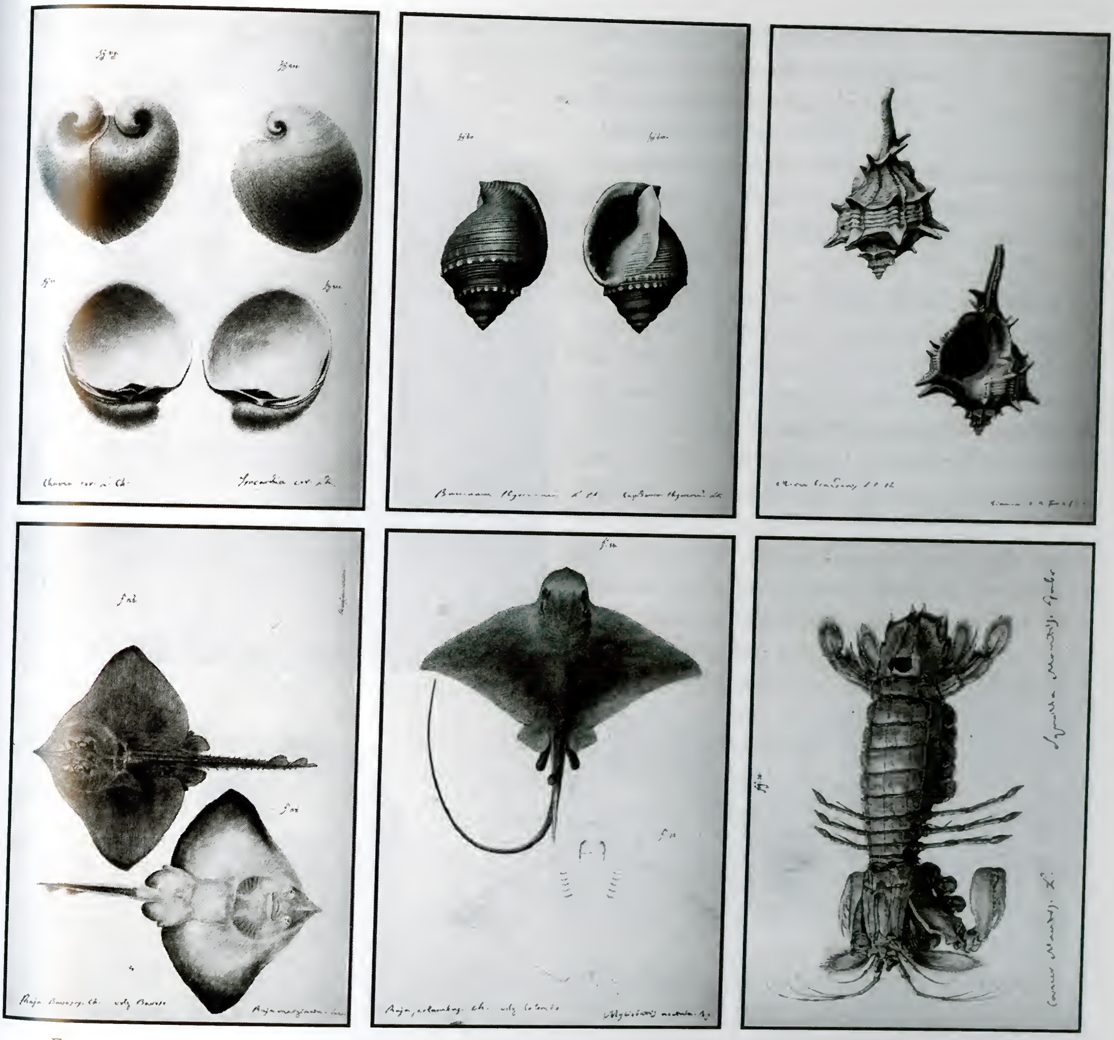


FIGURE 10. Some drawings of S. Chiereghin.

(1732–1780), Spallanzani gained useful field knowledge for his projects, which involved studies on marine biology along other Italian coasts, from Portovenere (in the Ligurian Sea, where he founded a biological station) to Messina and Rovinj. Giuseppe Olivi was part of this group, and the two naturalists certainly knew each other and exchanged views. But when he learnt that Olivi was about to publish his *Zoologia Adriatica*, Spallanzani was annoyed because he saw that the chance of being the first person to publish research on the Adriatic would elude him. He even refused to make the official presentation of the volume. Spallanzani was in fact known for such behaviour; he had already ferociously criticised Antonio Vallisneri *junior*, previously his master and advisor, and then publicly denigrated him as an Aristotelian: "*intriso di pece peripatetica*" ("soaked in peripathetic pitch") (Contardi 1994). The reasons for this behaviour lay not only in profound differences of opinion in the scientific field, but also on a more personal level because Vallisneri had not come up to his expectations of aid and protection.

After the fall of the Republic of Venice in 1797, the "Republic of Veneto Naturalists" was inevitably influenced by the climate of decay that afflicted all the territories formerly governed by

the *Serenissima*. The alternating French and Austro-Hungarian regimes changed the cultural life and the politics and economy of the Lombardo-Veneto region, with inevitable repercussions on scientific research. In the 19th century, Chioggia and the Veneto environment gave way to the city of Trieste.

In the mid-19th century, Trieste was the only sea port of the Hapsburg monarchy. After the fall of Venice, Trieste inherited its hegemonous role in the Adriatic and also, with the opening of the Suez Canal, throughout the Mediterranean. Spending more or less extended periods in Trieste, studying the marine flora and fauna of its sea, had become a pleasant habit for naturalists and scholars, who came not only from Austria and Germany, but from as far afield as Czechoslovakia, Poland and Russia. Among these was Karl Ernst Von Baer (1792–1876) (Fig. 11), the discoverer of the human egg cell. After his arrival in Trieste in 1845, he promoted a whole series of initiatives favouring the development of marine biology in Trieste. At this time, von Baer frequented a group of enthusiasts and keen naturalists, including Enrico Koch, a Swiss merchant, who was interested in malacofauna, and Muzio de Tommasini, a botanist and future *podestà* (mayor) of the city. Together, supported and financed by authoritative institutions, they made plans for founding a museum for Adriatic fauna: the "*Museo Zoologico e Zootomico*", which passed under the aegis of the city in 1852 under the name "*Museo Civico di Storia Naturale Ferdinando Massimiliano*". This name was opportune, since Ferdinand Maximilian (1832–1867), the unfortunate Prince of Mexico, (Fig. 12) was not only the brother of the Emperor Franz Joseph, but also a passionate naturalist, who had collected and brought to Trieste many findings from his journeys round the world. The first director of this museum was Koch, followed by the Slovene zoologist Enrico Freyer, the Venetian Enrico F. Trois, and, lastly, Simeone Adamo de Syrski (1829–1882), a doctor and naturalist of Polish origin. He had come to Trieste in 1866. He was an experienced researcher (to him goes the merit of having discovered the male gonads in the eel) who spent his time in Trieste studying the reproductive cycles

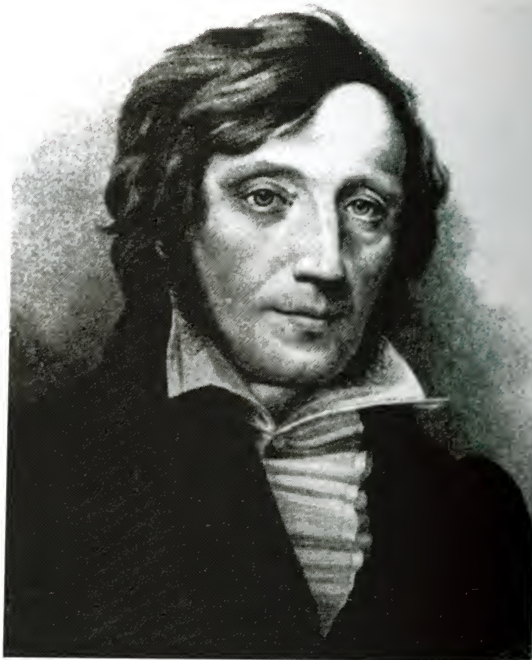


FIGURE 11. K. Ernst von Baer (1792–1876).

FIGURE 12. Ferdinand Maximillian von Habsburg (1832–1867).

of many marine animals, preceding the work of Eduard Graeffe (1833–1916). De Syrski also examined the "glutinous masses" of the high Adriatic, which we now call mucilage, or algal blooms. From his 1868 cruise on the corvette "Erzherzog Friedrich" in the Adriatic to areas as far-off as China, he collected an enormous quantity of material that enriched the collections for which he was responsible. The Museum was visited by other well-known scholars, including Johannes Müller (1801–1858), a famous embryologist, Adolph Eduard Grube (1812–1880), who classified its annelid collection, and Alexander O. Kovalevsky (1840–1901), who discovered sexual dimorphism in *Bonellia viridis*, and many others.

During these years, de Syrski had worked on a plan for a marine biology station directly on the sea, at Barcola, near Trieste (Stenta 1922), and although it was a goal he never achieved, nonetheless a station was in time completed by Carl Claus of Vienna and F.E. Schulze of Graz. Thus, the *Imperial Regia Stazione Didattica e di Osservazione Zoologica di Trieste* came into being, as a separate department of the University of Vienna. The Trieste station was visited by so many authoritative scientists that it would take too long to list them here, although brief mention must be made of Eli I. Metchnikoff (1845–1916), father of immunology, who studied phagocytosis in invertebrates, and Hans Driesch (1867–1941) who carried out fundamental research on the embryological development of the sea urchin in 1891.

In the first years of the 20th century, the *Stazione Zoologica di S. Andrea* was enlarged, had its own resident personnel, and was directed by Professor Karl Cori of the German university at Prague, with his assistant Adolf Steuer, a well-known expert on plankton. Between 1904 and 1910, many oceanographic cruises were organised all along the Adriatic in the *Argo* and *Adria* ships. They were not the only ships to sail the Adriatic for purposes of scientific research in those years: also the *Stazione Zoologica di Rovigno*, established in 1891, stemming from the Berlin Aquarium (Fig. 13), promoted several cruises in the research vessel *Rudolph Vircow*. After the First World War, the Station passed to the *Regio Comitato Talassografico Italiano* and was renamed the *Istituto Italo-Germanico di Biologia Marina*.

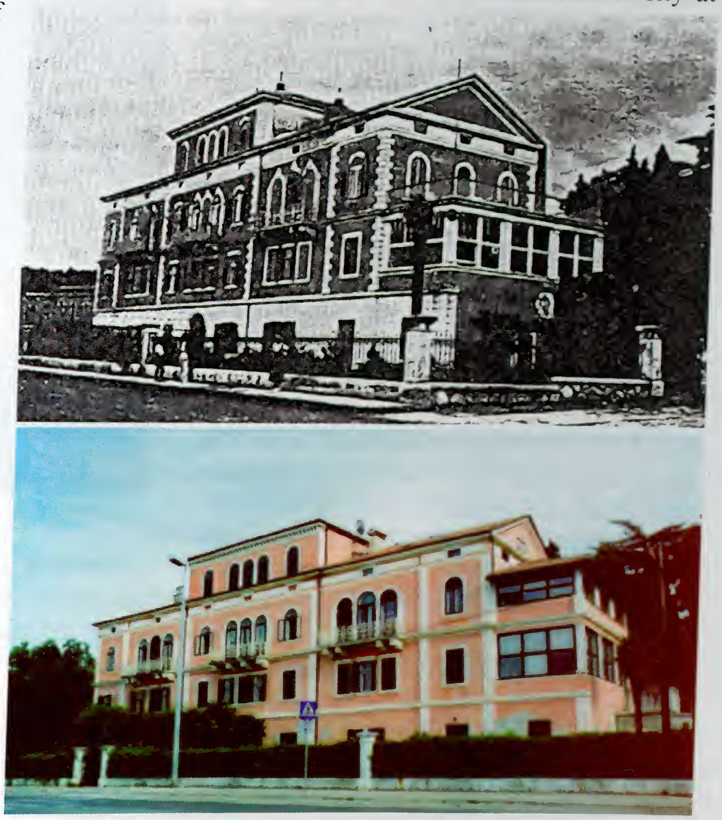


FIGURE 13. Above: Zoological Station in Rovinj at the beginning of 1900. Below: today the Center for Marine Research, at Rovinj is a Department of the Ruder Bošković Institute of Zagabria.

In 1899, the first *Congresso Italiano di Pesca* (Vinciguerra 1899) took place in Venice, followed in 1910 by a conference of the delegates of the Institute for Adriatic Studies, again in Venice. The aim was to create an interna-

tional organisation under the aegis of which common research programs could be carried out. Austria and Italy were the first members, followed later by Turkey and Montenegro. There thus arose the *Commissione Internazionale per lo studio dell'Adriatico* that, between 1910 and 1914, organised five large-scale cruises in which the researchers from the Trieste station took part. But war loomed and, when hostilities broke out, the researchers were called to fight for their countries, their work-benches remained deserted, and the Station was obliged to close. The aquaria were emptied and the animals they had housed were thrown back into the sea. Part of the very rich library was sent to Vienna, from whence it never returned, not even after the Treaty of St. Germain, according to which Austria was obliged to return all scientific and bibliographic materials taken from conquered territories, and part remained in Trieste, until it was taken to the Italo-German Station at Rovinj in 1919. The botanical and zoological collections were also taken there, where they remained until 1943, when by good fortune they were taken to Venice and housed first in the basement of the Institute for Adriatic Studies and then at the Museum of Natural History, where they were also displayed to the public for a short time. It was only in 1968 that they finally reached the *Stazione Idrobiologica di Chioggia*.

FIGURE 14. Umberto D'Ancona (1896–1964).

The history of this institution is recent, but may be set against the background of the unquestioned disciplinary tradition of past centuries. It was established by Umberto D'Ancona (1896–1964) (Fig. 14), who had arrived in Padova from Pisa in 1937 to occupy the Chair of Zoology and Comparative Anatomy, which had been left vacant when its previous incumbent, Pasquale Pasquini (1901–1977), moved to Bologna. When he arrived in Padova, D'Ancona was only 41 years of age, but was already an important figure in the scientific community of the time. His inaugural lecture at the first course of Zoology, read in the Aula Magna of the University of Padova on December 9, had as its title "Chromosomes and sexual hormones", but his scientific experience had already covered the most disparate fields: biology, experimental embryology, hydrobiology, ichthyology and fisheries. In particular, he had been involved in fisheries studies ever since he had been an assistant at the *Comitato Talassografico Italiano*. Carefully analysing data on fishing in the high Adriatic between 1905 and 1923, with particular reference to the reduced pressure of fishing during the First World War, he had observed that, contrary to expectations, fish species that fed on plankton had not increased in numbers. Instead, only some species of predatory fish, at the top of the food chain, such as selachians (sharks, skates, rays, etc.), had increased. Correctly, D'Ancona interpreted these data as indicating a return to a state of natural equilibrium, favoured by the cessation of human interference. A proper explanation from a statistical and mathematical viewpoint came from Vito Volterra, (Volterra 1926) his father-in-law and an illustrious mathematician of international fame. Indeed, his son-in-law's research later inspired Volterra to formulate laws of biological fluctuations and prey-predator interactions (Lotka-Volterra models). Shortly after his arrival in Padova, D'Ancona worked on a project that reveals his ever intense interest in marine

biology. Born at Fiume (now called Rijeka, in Istria) in 1896, D'Ancona had the sea in his blood, and the Lagoon of Venice is only a short distance from Padova. He was able to arrange for the University of Padova to use a small public building on the island of San Domenico a Chioggia as a centre for marine and lagoonal research. Writing in 1939 in the original manuscript volume of the directors of the *Gabinetto di Zoologia* (with its *imprimatur* by Antonio Tomaso Catullo (1782–1869) of 1735), he stated: "work has begun for the establishment at Chioggia of a small laboratory for lagoonal research...."The *Stazione Idrobiologica di Chioggia* was opened in 1941, although activities were considerably hampered in the following years by the war. In 1946, with the nomination of the first true assistant, Armando Faganelli, a series of hydrographic and biological researches began, coordinated by Aristocle Vatova (1897–1992) (Fig. 15). Also Istrian by birth, Vatova had been nominated in 1924 by the *Regio Comitato Talassografico Italiano* as a temporary assistant and responsible for the provisional management of the Institute of Marine Biology at Rovinj (Fig. 13). He became its executive director in 1929. From 1931 to 1943, under his directorship the Institute published two reviews: *Thalassia* and *Note dell'Istituto di Biologia di Rovigno*. He had carried out much research in the intervening years and had published the "*Compendium of flora and fauna of the Adriatic Sea near Rovinj*" (Vatova 1928). In particular, since 1928 he had begun to study benthic fauna, which was to remain one of his ongoing research themes until the last years of his life. Between 1937 and 1938, he directed a daring scientific expedition in East Africa. In 1943, the war had obliged him to leave Rovinj. At Venice, where he moved with his family, he was able to reconstruct a centre for marine biological research at the *Osservatorio per la Pesca Marittima*, in a building belonging to the Italian *Regio Comitato Talassografico*, that later gave rise to the present *Istituto di Biologia del Mare* (later directed by D'Ancona). In 1955, Vatova left Venice, and moved first to the University of Camerino and then to that of Taranto. He returned to Venice only after he had retired, in the early 1970s. Many of us are well acquainted with the quality of his scientific output. Indeed, his works on the benthic fauna of the Adriatic coasts and the Lagoon of Venice are still points of reference for useful comparisons on the evolution of benthic biotopes, more than 50 years after he wrote them. His publications reveal great competence in highly varied sectors of marine biology, from the chemistry and physics of water, to the phenology of marine algae, and the effects of flooding on the fauna of the brackish *valli* of the Polesine area, near the mouth of the Po. Further testimonies of the collections made during the many oceanographic cruises in which he took part are the enormous numbers of preparations of marine animals, still conserved at the *Stazione Idrobiologica di Chioggia*, where the original nucleus of the collections in the *Stazione Zoologica di Trieste* can still be identified.

FIGURE 15. Aristocle Vatova (1897–1992).

Recently, thanks to renewed interest in museum collections, which led to a new institution of the University of Padova, the *Centro d'Ateneo Museale*, restoration and recataloging of these preparations have begun, although the disastrous effects of decades of complete neglect are, unfortunately, too obvious.

This historical review must stop here, faced with the multiplicity of so many researches in the field of marine biology and the national and international initiatives that have covered and still cover the most recent researches on the Adriatic Sea. Today, check-lists of its fauna and flora are updated in real time. But this very particular environment must cope with pollution, eutrophication, the rise in water temperature due to the greenhouse effect, and invasion by allochthonous species from subtropical and tropical seas. The monk seal has long since disappeared; *Acetabularia* is no

longer as abundant as in Donati's times; and mucilage and episodes of anoxia are much more frequent than in the past. And yet, the Adriatic still manages to surprise us. Those of us who, in the last few decades, have been able to study one very peculiar environment of this sea — the so-called *tegnùe*, rocky outcrops found at depths of between 18 and 40 metres, off the north Adriatic coast from Grado to Ravenna — are aware of this. *Tegnùe* are similar to coralligenous environments, true oases of biodiversity (Fig. 16), on the flat, homogeneous sea bed typical of this part of the Adriatic. We must not forget that it was Olivi himself, at the end of the 18th century, who signalled their presence, on the basis of fishermen's tales. Neglected for centuries, they were "rediscovered" in 1966: not even Olivi himself would have ever been able to imagine the richness of the fauna!

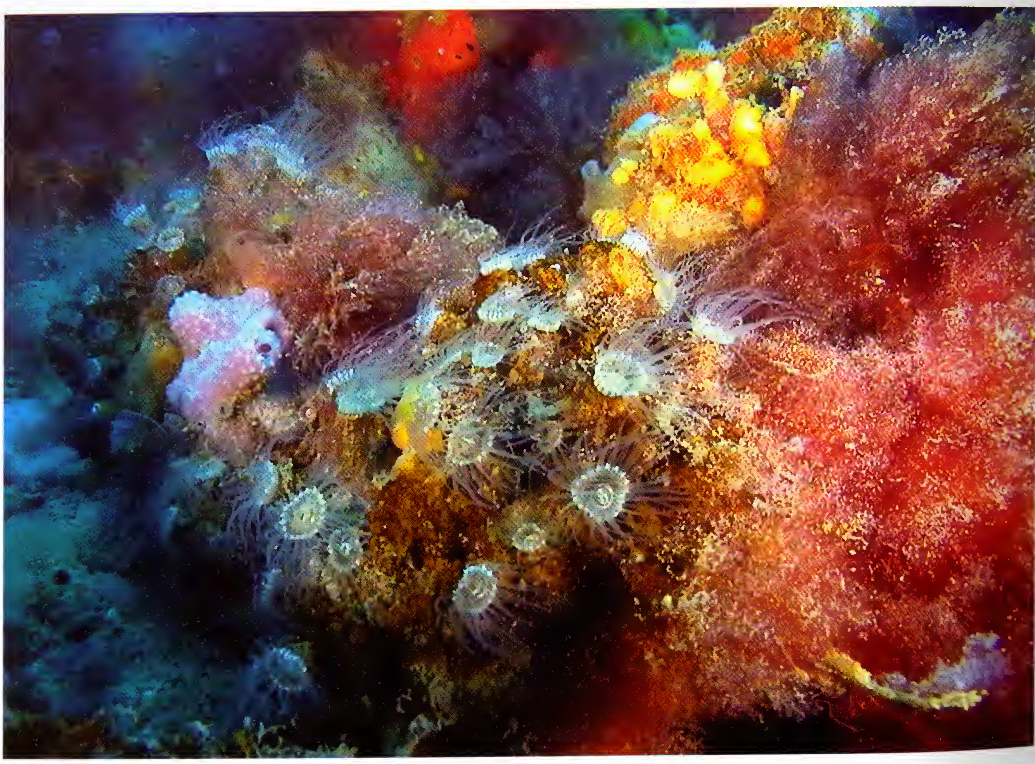


FIGURE. 16 The faunal benthic community of an Adriatic rocky outcrop at 23 m depth.

BIBLIOGRAPHY

CASELLATO, S., E. SICHIROLLO, L. MASIERO, and S. SORESI. 2007. The hidden secrets of the Northern Adriatic: the "tegnue", peculiar reefs. *Central European Journal of Biology* 2(1):122–136.

CONTARDI, S. 1994. *La rivincita del filosofi di carta: saggio sulla filosofia naturale di Antonio Vallisneri junior*. Leo Olschki, Firenze, Italia.

DONATI, V. 1750. *Della storia naturale marina del Mar Adriatico. Saggio del signor dottore Vitaliano Donati giuntavi una lettera del signor dottore Lionardo Sesler intomo ad un nuovo genre di piante terrestri.* Francesco Storti, Venezia, Italia.

GIBIN , C. 1997. *L'esplorazione del Golfo di Venezia. I disegni del naturalista chioggiotto Stefano Chiereghin per Lazzaro Spallanzani*. T & G Edizioni, Conselve, Padova, Italia. 153 pp.

GIBIN, C., ED. 2001. Stefano Chiereghin. Descrizione dè Pesci, dè Crostacei e dè Testacei che abitano le lagune e il Golfo Veneto. Canova, Treviso, Italia. 2 vols. xlviii + 982, 829 pp.

MARSILI, L.F. 1725. Histoire physique de la mer. De'Pens, Amsterdam, Netherlands. 570 pp.
NARDO, G. 1877. Bibliografia cronologica della fauna del Mar Adriatico. *Atti Regio Instituto Veneto. di Scienze, Lettere ed Arti.*
OLIVI, G. 1796. *Zoologia Adriatica, ossia, catalogo ragionato degli animali del Golfo e della lagune di Venezia, preceduto da una Dissertazione sulla storia fisica e naturale del golfo; e accompagnato da memorie, ed osservazioni di fisica, storia naturale ed economia dellÁbate Giuseppe Olivi*. Giuseppe Remondini, Bassano, Italy. xxxii + 334 pp., 9 tables.
RENIER, S.A. 1793. Sopra il Botrillo plantanimale marino. Lettera al Signor abate G. Olivi, Chioggia.
STENTA, M. 1922. Trieste negli studi di Biologia marina. *Atti della Società Italiana per il progresso delle Scienze* 15:1–21
VALLISNERI, A. 1708 . Nuova scoperta delle uova, ovaja e nascita delle anguille. *In* Opere fisico-mediche stampate e manoscritte dal Kavalier Antonio Vallisneri. Raccolte da Antonio Vallisneri suo figliuolo. 1733, Venezia 2:89–95.
VATOVA, A. 1928. Compendio della Flora e Fauna del Mare Adriatico presso Rovigno con la distribuzione geografica delle specie bentoniche. *Regio Comitato Talassografico Italiano. Memoria* 142. Officine Grafiche C. Ferrari, Venezia, Italia. 614 pp.
VIANELLI, G.M.F. 1749. Nuove scoperte intorno le luci notturne dell'acqua marina spettanti alla naturale storia; fatte da Giuseppe Vianelli. Francesco Pitteri, Venezia, Italia.
VINCIGUERRA, D. 1899. Il primo Congresso italiano di Pesca. *Rivista Marittima*, novembre 1899:1–18.
VOLTERRA, V. 1926. Variazioni e fluttuazioni del numero d'individui in specie animali conviventi. *Memorie della Reale Accademia dei Lincei. Classe di scienze fisiche, matematiche e naturale* 2:31–113.
ZANICHELLI, J.G. 1722. Relazione popolare sopra un vitello marino preso nell'Adriatico, vicino a Rovigno, Venezia.

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Scientific Travels and the Wealth of Nations

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Even if I am not an expert on scientific travels — apart from those of Ulysses — that have explored and exploited all seas and oceans, I would like to take this opportunity to touch upon some of the political and economic implications of scientific exploration throughout the course of history that will allow me to connect the history of scientific travel and exploration to the history of museums, a topic that has interested me for quite some time. In this essay, I emphasize two points, neither of which is new. First, scientific discoveries, irrespective of whether they are true or false, arise from or are accelerated by political and economic conflict. And second, museums, including those devoted to natural history, and the collections that they house, simultaneously create and represent the wealth of nations.

Science and Conflict

A recent book by Jacob Darwin Hamblin[2] makes it clear that the birth of plate tectonics in the 1960s had its roots in the discovery of ocean floor spreading, the discovery of which was, in turn, the result of geological surveys carried out for military purposes by the United States Navy. In a book on the decline and fall of the dinosaurs, published in 1980, and, therefore, some nine years before the fall of the Berlin Wall, I highlighted the point, which had been evident to others as well, that the success of the meteor theory of the extinction of the dinosaurs together with many other species was due to the end phases of the cold war.[3] Therefore, we should attribute to the cold war both the extraordinary theory of plate tectonics, and all that succeeded it, and the hare-brained idea that a meteor could have caused the extinction of the dinosaurs (and of many other living species), an idea that was supported by the American government establishment, including NASA, in order to justify the "star wars" policy of Ronald Regan.

The correlation between conflict and acceleration of scientific research is an historical constant, one that embraces the burning glass of Archimedes, the studies by Fritz Haber on gas for military use during the First World War, and the nuclear research carried out during the Second World War. Leaving aside the ethical issue of whether science should or should not be held to account for the undesirable consequences of its results, the motivation for much research may be found in the subjection of science to economic and political interests. The same appears to hold true with respect to those investigations of nature that were carried out during the 17th to 19th centuries that greatly broadened our knowledge of the earth's geology and biology, as well as giving rise to astounding theories capable of altering Man's conception of himself.

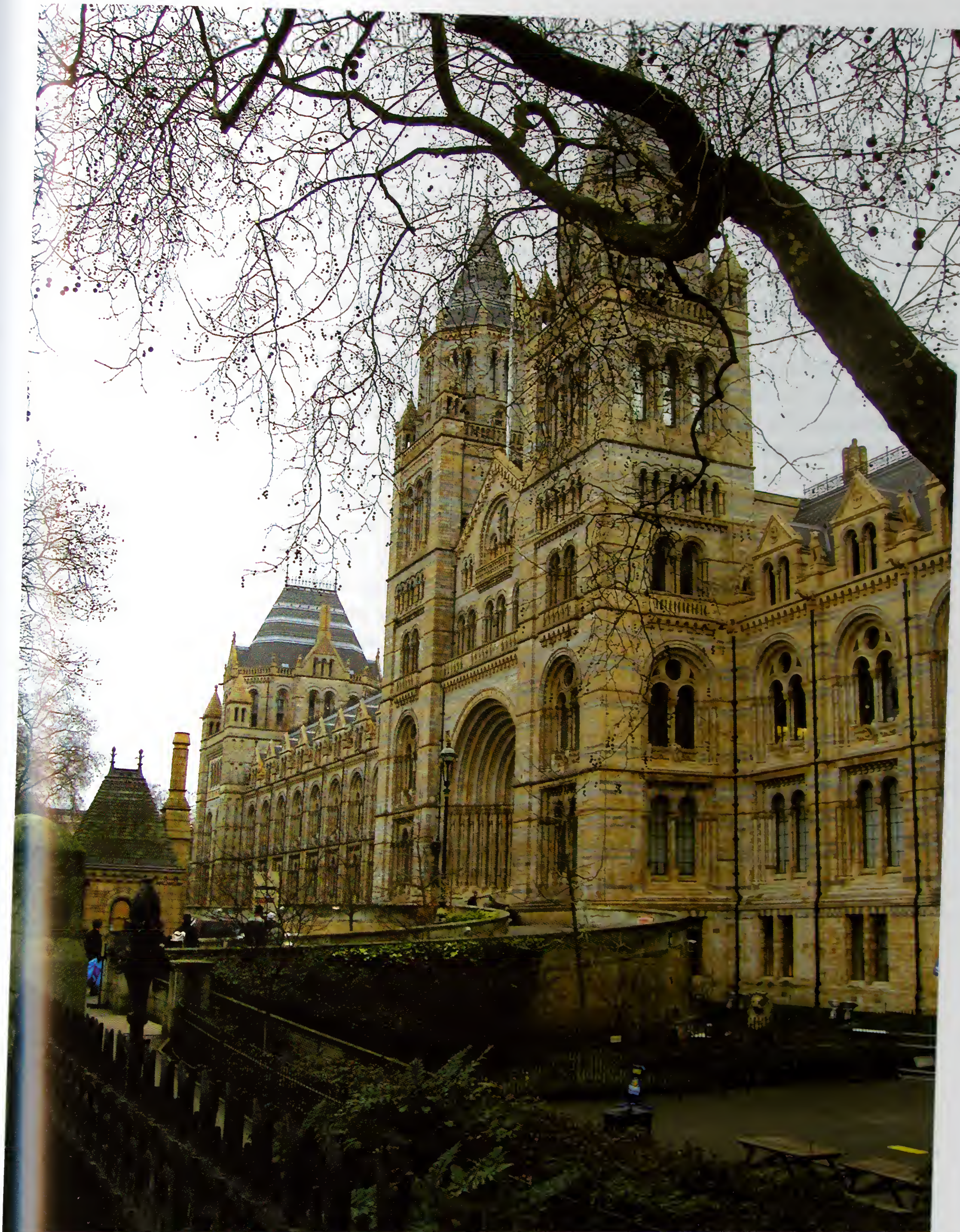
The travelers and expeditions that criss-crossed the earth, most especially all of the seas, from the 17th through the 19th centuries, were nearly always the product of competition among the European nations. In addition to confronting one another on both land and sea, these nations struggled for the acquisition of new territories, the opening of new markets, and the affirmation of their own supremacy. These conflicts, not always bloodless, though in appearance they may have seemed so, made it necessary to explore, survey, and acquire knowledge of the seas, to create maps of the

world, and to raise flags upon on lands until then unknown. After the defeat of Spain's *Invincible Armada* in August 1588, an event that severely diminished the country's capacity as a naval power, the routes of the world were opened to England, France, and Holland. Beginning in the 17th century, these nations began to assemble their colonial empires. Not infrequently, they came to blows over both smaller and larger strips of land in the Americas, the West Indies, South America, southern Asia, and the Pacific. The voyages of the Frenchmen La Pérouse and Bougainville and the Englishmen Cook and Fitz-Roy — just for mentioning the most famous — were aimed at the construction of empires.

The study of fauna and flora were not the main aims of these expeditions, which were carried out mainly by ships-of-the-line of the respective countries. Nonetheless, such study became customary, for shrewd politicians recognized in them a new and unexplored source of power. Therefore, there were naturalists and draftsmen on board the exploring vessels of the Marine Royale and the Royal Navy, sometimes supported at their own expense, but charged with describing plants and animals and making collections that would enrich the national museums in the empires' capitals. By comparison with the exploration carried out by the Spanish and Portuguese during previous centuries, this practice amounted to an important intellectual revolution, one that laid the foundations of natural science, furthered an interest in its development, and led to the establishment of ever more numerous natural science museums and scientific societies.[4]

This custom continued throughout most of the 19th century. For instance, the voyages around the world of the Austrian frigate *Novara* (1857–1859) and the Italian Frigate *Magenta* (1865–1868) had as their primary aim the training of naval officers and cadets, but they were not neglectful of bringing their national flags to the most remote parts of the globe. Indeed, the very names *Novara* and *Magenta* symbolized the longstanding rivalry between Austria and Italy, for each was a reminder of a victory in battle over the rival nation. Likewise, the British *Challenger* expedition (1872–1876) was not motivated by the interests of pure science. Its most important task was to survey the depths of the oceans in support of submarine telegraph cables. Likewise, after the Second World War, the U.S. Navy explored the deep sea with the needs of the military in mind.

Naval efforts to increase knowledge of the natural world were enriched by those of others. Physicians, employed by commercial firms, government administrators, and naval and army officers sent to the colonies often dedicated themselves to the study of exotic flora and fauna. They did so partly out of intellectual curiosity, partly to overcome the sense of isolation and, perhaps, boredom that goes with living in a remote situation. Many assembled collections that have made some museums famous. Like the naturalists on board ships, their artists provided volumes that illustrated exotic worlds, thus providing a basis for research by scientists as well as treasures for wealthy bibliophiles. Hans Sloane (1660–1753), for example, studied and described the natural history of Jamaica while he was physician to the governor of that island, the Duke of Albemarle.[5] In the years following, he became quite wealthy. The discovery of cacao and, above all, the way of preparing chocolate (the celebrated Sir Hans Sloane's Milk Chocolate) may have had something to do with it. He amassed a personal collection that became the basis for the British Museum, the most prestigious museum in the world. Likewise, Paul Hermann, to whom we owe the first study of the flora of Ceylon, was physician to the Western Company of the Dutch Indies. Joan Gideon Loten, employed by the same company and later by the Dutch Governor of Ceylon from 1752 to 1757, commissioned a series of 154 watercolors, now preserved in the British Museum, on the natural history of that island. The service of such explorers in commercial companies and colonial administrations illustrates how much of their science was, directly or indirectly, the product of political or commercial rivalry. This is true even though there were also independent travelers motivated by a love of science, such as Alexander von Humboldt, who lived off his rich patrimony, and Alfred



The Natural History Museum, London (formerly British Museum [Natural History)
by Architect Alfred Waterhouse (1880). Photo by Giovanni Pinna

Russel Wallace and Henry Walter Bates, who covered their expenses by the sale of specimens. A combination of politics, scientific progress, development of knowledge on the one hand, and search for national cultural and economic authority on the other, is to be found in most exploratory travel. Particularly toward the close of the 17th century, the concept of cultural authority began to infiltrate and ultimately become part of state policy. Many governments began to realize that such authority could be a resource that had a positive influence on commercial relationships with other nations.[6]

The Wealth of Nations

In the history of nations, there has always been a close link between economic and military power on the one hand and the capacity for scientific production on the other; thus, powerful cultural machines have always been accompanied by a strong productive capacity and a robust military apparatus. Gordon Childe[7] claims that science, and art as well, developed when the Neolithic revolution created a surplus of resources that could be used to liberate some individuals, including artists and scientists, from the labor of food production. According to Childe, the initial propellant for art and science was productive capacity and, therefore, the economy. Although I agree with him, it seems to me that the relationship between economic productivity and scientific and artistic production was reversed almost immediately with the development of the first complex societies and the birth of the first nation-states. In Sumer, Assur, Memphis, and Thebes, art and science were no longer secondary byproducts of economic and military power. Rather they were themselves elements of this power, and they played a role in promoting the growth of the authority of kings and Pharaohs. In the modern world, the relationship between cultural development and economic power is tipped in favor of the latter. Cultural policies in the majority of European countries have served and continue to serve for the development of commercial exchange and the conquest of new markets because it is understood that cultural authority is stronger than armies.

This has been known for some time, as the words of Adam Smith demonstrate: "Noble palaces, magnificent villas, great collections of books, statues, pictures and other curiosities, are frequently both an ornament and an honour, not only to the neighbourhood, but to the whole country to which they belong. Versailles is an ornament and an honour to France, Stowe and Wilton to England. Italy still continues to command some sort of veneration by the number of monuments of this kind which it possesses, though the wealth which produced them has decayed, and though the genius which planned them seems to be extinguished, perhaps from not having the same employment."[8]

The point he was making in 1776, a little more than twenty years after the British Museum was established and one year after Cook completed his second voyage, was that the cultural authority of a country was essential for its economic development and that the cultural institutions, palaces, and works of art, were tools for constructing that authority.

Museums are the institutions that, thanks to the accumulation and intellectual reworking of scientific, artistic and historical objects, preserve and communicate the memory, identity and the history of nations, of companies, of ethnic groups, and of religious organizations. They communicate along two lines, i.e., internally and externally to the nation, the company or the group that expressed them. They function simultaneously as tools for affirming the identity and as the means of expression of the authority of nations, companies, and groups. Their activity, therefore, plays a political role. Internally it reinforces the legitimacy of government (in the case of nations) or of property (in the case of companies). Externally it imposes, or attempts to impose, the authority of the nation, the company or some other groups. Thus, as Adam Smith would have suggested, by imposing cultural authority museums play an important role in the national economy and in the

subjects of which the museum are expressions. It would be myopic indeed for nations to consider museums only as a source of direct income through tourism, gadgets, and illustrated postcards.

Thus, I am convinced that it is no longer completely true that the rich countries possess the best and the largest museums. Rather, the museums that are more authoritative, both culturally and scientifically, enrich the nations that possess them. Caught up in this network of economic and political use of museums, nations both great and small are now involved in a sort of "war" with ever more powerful, more beautiful, and more dazzling museums used as weapons in the hope of winning a victory over the competition.

During past centuries museums played analogous roles. They were established to house and preserve the collections that represented the memory of the nation and thus serve, together with an increase in cultural production and the enlargement of the capacity for communication, as a means for legitimizing the power and authority of the nation. The development of museums always corresponded to the development of empires. Museums had the purpose of representing the imperial power, first domestically and then to foreign peoples. There are no empires that did not construct a museum, or fail to enlarge it, while the empire flourished. In Europe, the French, English, Spanish, Austrian, Russian, and Ottoman empires all had their imperial museums. In the United States, although social, economic, and political conditions were somewhat different, its museums, just as powerful, have played a similar role in representing the economic power and expansionist proclivities of the "New Empire". In all of these museums one will find assembled the collections that naturalists brought back from the field. Each collection constituted another increase in the authority of the nation, demonstrating its ability to explore the world in the name of mankind while at the same time gaining physical and intellectual possession of distant lands.

Similarly, the colonial museums expressed the alliance between scientific travel, political power, and economic development. Like the Great Exhibition held in London in 1851, metropolitan colonial museums were simultaneously historical testimonials, expressions of national identity, and ties between the mother country and the colonies. Once again, the theme was the economic expansion of the nation.[9] Referring to the colonial museum in Haarlem, Susan Legêne writes: "Le Musée Colonial peut être considéré comme l'expression directe des intérêts économiques et sociaux des élites hollandaises, à une époque où le colonialisme ètait très largement accepté comme une partie intégrante de l'identité nationale hollandaise."[10] With the transformation of colonies from territories of pure exploitation to new markets, and pressure from middle-class immigrants from the home country, part of the scientific and artistic products had to be left *sur place*. Thus, the overseas colonial museums came into being. In the major cities of Australia, New Zealand, Canada, India, Indochina, and the Dutch Indies, museums that had dual functions were established. First, they represented the local ruling class, which started to acquire more autonomy. Second, they demonstrated the power of the empire to the colonials.[11] Initially, at least, these museums could only be facsimiles of the major ones, not only in terms of architecture and organization, but also in the specialized staff, which was largely recruited from the homeland, as Susan Sheets-Pyneson has suggested.[12]

The decline of colonialism after the Second World War provides decisive proof of the political and economic value of museums. The abandonment of colonies by the European nations brought an end to the majority of metropolitan colonial museums, which had arisen as "war trophies," such as the Italian Museo Coloniale del Ministero dell'Africa and the Musée National des Arts d'Afrique et d'Océanie in Paris. On the other hands, the overseas museums were freed from their former dependency, and upon being converted into national museums took on a new role in the service of the authority, credibility, and economy of the newly independent nations.[13] Nevertheless, cultural colonialism, with its economic repercussions, was not completely eliminated by

Evocative frescoes of Pierre-Henry Ducos de La Haille in the building erected for the Exposition Coloniale de Paris (1931), as Musée Permanent de Colonies. The museum changed several times: in 1935 became Musée de la France d'Outre-mer, in 1960 Musée des Arts Africains et Océaniens, in 1990 Musée National des Arts d'Afrique et d'Océanie, and in 2007 Cité Nationale de l'Histoire de l'Immigration. Photo by Giovanni Pinna

For explanation see figure legend p. 210

For explanation see figure legend p. 210

Western museums but rather took on a new form.By reaffirming the Eurocentric view of "other" cultures by emphasizing aesthetics, as in the new Musée du Quai Branly[14], or by cultural cooperation, the power of the European museums and, therefore, the wealth of the nations to which they belong was similarly reaffirmed.[15]

The Flag on the Shore

In 1972, an Italian scientific expedition to the Gadoufaouà site in Nigeria in search of dinosaurs, an expedition in which I participated, was blocked by France, which at the time was an important advisor to the government of that country, known for its important uranium mines.[16] The intermediary in this maneuver was the Muséum National d'Histoire Naturelle of Paris. Its paleontologists had been exploring Gadoufaouà for quite some time and sought to maintain their monopoly. Apart from possible political repercussions — France was then developing its own nuclear power industry — it was surprising that the heirs of the Enlightenment should arrogate to themselves total and exclusive control over an immense paleontological site, thus perpetuating the colonial view of raising the flag that had guided the European nations in the conquest of empires.

«Suffira-t-il de mettre le pied sur un terrain commun pour s'en prétendre aussitôt le maître ? Suffira-t-il d'avoir la force d'en écarter un moment les autres hommes pour leur ôter le droit d'y jamais revenir? Comment un homme ou un peuple peut-il s'emparer d'un territoire immense et en priver tout le genre humain autrement que par une usurpation punissable, puisqu'elle ôte au reste

Hyderabad State Museum, Hyderabad, India
Photo by Giovanni Pinna

Raffles Museum ca. 1900, now National Museum of Singapore
Courtesy A. Leviton, California Academy of Sciences

des hommes le séjour et les aliments que la nature leur donne en commun? Quand Nuñez Balbao prenait, sur le rivage, possession de la mer du Sud et de toute l'Amérique méridionale au nom de la couronne de Castille. était-ce assez pour en déposséder tous les habitants et en exclure tous les princes du monde? Sur ce pied-là, ces cérémonies se multipliaient assez vainement; et le roi catholique n'avait tout d'un coup qu'à prendre possession de tout l'univers, sauf à retrancher ensuite de son empire ce qui était auparavant possédé par les autres princes.»[17]

Notes

[1] Former Director of the Natural History Museum of Milan; President of the Italian Association for Studies on Museology.

[2] Jacob Darwin Hamblim. 2005. *Oceanographers and the Cold War: Disciples of Marine Science.* University of Washington Press, Seattle, Washington, USA.

[3] Giovanni Pinna. 2000. *Declino e caduta dell'impero dei dinosauri.* Il Saggiatore, Milano, Italy.

[4] Gillian Beer. 1996. *Travelling the other way.* Pages 322–337 *in* N. Jardine, J.A. Secord, and E.C. Spary, eds., *Cultures of Natural History.* Cambridge University Press, Cambridge, UK.

[5] *A voyage to the Islands Madera, Barbados, Nieves, S.Christophers and Jamaica with the Natural History of the Herbs and Trees, Four-footed Beasts, Fishes, Birds, Insects, Reptiles, &c. Of the last of those Islands.* By Hans Sloanes, London 1707-1725.

[6] Janet Browne. 1996. *Biogeography and empire.* Pages 305–321 *in* N. Jardine, J.A. Secord, E.C. Spary, eds., *Cultures of Natural History.* Cambridge University Press, Cambridge, UK..

[7] V. Gordon Childe. 1942. *What Happened in History.* Penguin Books. Harmondsworth, UK.

[8] Adam Smith. 1776. *An Inquiry into the Nature and Causes of the Wealth of Nations.*W. Strahan and T. Cadell, London, UK. Vol. I, p. 423.

[9] Sabine Cornelis. 2000. *Le musée du Congo belge, vitrine de l'action coloniale (1910–1930).* Pages 71–86 *in* Dominique Taffin, ed., *Du musée colonial au musée de cultures du monde.* Musée national des Arts d'Afrique et d'Océanie, Paris, France.

[10] Susan Legêne. 2000. *Identité nationale et "culture autres": le Musée colonial comme monde à part aux Pays-Bas.* Pages 87–101 *in* Dominique Taffin, ed., *Du musée colonial au musée de cultures du monde.* Musée national des Arts d'Afrique et d'Océanie, Paris, France.

[11] Regarding this point refer to the chapter "Il museo" in the book by Benedict Anderson *Comunità Immaginate. Origine e diffusione dei nazionalismi.* Manifestolibri, Roma, pp.179–186 (original title *Imagined Communities*, Versom, London 1991).

[12] Susan Sheets-Pyneson. 1988. *Cathedrals of Science.* McGill-Queen's University Press, Kingston and Montreal, Canada.

[13] Nélia Dias. 2000. *Musées et colonialism: entre passé et présent.* Pages 13–33 *in* Dominique Taffin, ed., *Du musée colonial au musée de cultures du monde.* Musée national des Arts d'Afrique et d'Océanie, Paris, France. Completely new national museums arose during the 1960s and 1970s in many newly independent countries lacking colonial museums, such as Niger (Giovanni Pinna. 1974. Il Museo Nazionale del Niger a Niamey. *Natura* 65(3-4):238-246).

[14] Valentina Lusini. 2004. *Gli oggetti etnografici tra arte e storia. L'immaginario postcoloniale e il progetto del Musée du quai Branly a Parigi.* L'Harmattan Italia, Torino, Italy.

[15] Who really holds the power in international organizations such as the International Council of Museums?

[16] Giancarlo Ligabue, Giovanni Pinna, Augusto Azzaroli, Philippe Taquet. 1972. *I dinosauri del Teneré.* Longanesi, Milano, Italy.

[17] Jean-Jacques Rousseau. 1762. *Du contrat social, ou principes du droit politique.* Marc Michel Rey, Amsterdam, Netherlands.

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